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INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

GL BULLETIN

NO. 11

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INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

IFYGL BULLETIN NO.11

JULY 1974

UNITED STATES

DEPARTMENT OF COMMERCE

DEPARTMENT OF DEFENSE

DEPARTMENT OF INTERIOR

DEPARTMENT OF TRANSPORTATION

ENVIRONMENTAL PROTECTION AGENCY

NATIONAL SCIENCE FOUNDATION

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CANADA

ENVIRONMENT CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

ONTARIO MINISTRY OF THE ENVIRONMENT

ONTARIO MINISTRY OF NATURAL RESOURCES

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CONTENTS

CANADA AND UNITED STATES

IFYGL SYMPOSIUM

A special session of the Hydrology and Meteorology Sections of the Fifty-Fifth Annual Meeting of the American Geophysical Union held in Washington, D.C., in April will be published by the U.S. IFYGL Project Office, NOAA, as "Proceedings, IFYGL Symposium, Fifty-Fifth Annual Meeting of the American Geophysical Union, April 8-12, 1974." Additional papers on IFYGL were presented by Canadian and United States scientists at other sessions of the meeting. These will not be included in the Proceedings.

More than 50 papers dealing with IFYGL have been submitted for presentation at the 17th Conference on Great Lakes Research to be held at McMaster University in Hamilton, Ontario, August 12-14, 1974.

STATUS REPORT ON INTERCOMPARISON PROJECTS CONDUCTED DURING IFYGL

F. Elder and A. Robertson

Intercomparison studies conducted during IFYGL that have been identified to date are listed below.

Meteorology and Physics

Almazan, J., J. Ching, and R. Hovanec, "Comparison of July Meteorological Data From Adjacent United States and Canadian Buoys at Station 13." In preparation at CEDDA, NOAA.

Bennett, E.B., J. Saylor, J. Scott, and F.C. Elder, "Results from an Intercomparison of Measurements from Deep Water Lake Buoy System," IFYGL Bulletin No. 3. Manuscript held by J. Scott.

Elder, F.C., and F.M. Boyce, "Summary of E.B.T. Intercomparison Tests," CCIW Internal Memorandum. Available through CCIW and CEDDA.

Elder, F.C., and B. Brady. "A Meteorological Buoy System for Great Lakes Studies," Technical Bulletin No. 71, CCIW. Available through CCIW and CEDDA.

Elder, F.C., and R. Latimer, "Summary of Radiation Intercomparison Tests," CCIW Internal Memorandum. Available through CCIW and CEDDA.

Murthy, C.R., "A Comparison of Lagrangian and Eulerian Current Measurements in Coastal Waters of Lake Ontario," Proceedings of the 16th Conference on Great Lakes Research. Available through CCIW and CEDDA.

Pickett, R.L., and F.P. Richards, "Comparison of July Currents from Adjacent U.S. and Canadian Buoys." Available from Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

Pickett, R.L., and F.P. Richards, "Comparison of July Temperature Statistics From Adjacent Buoys at Station 13," IFYGL Bulletin No. 10. Available from GLERL, NOAA, Ann Arbor, Mich.

Pinsak, A., "U.S. Buoy Data Assessment, July 7-14, September 8-13, and October 30-November 6, 1972," Manuscript available from A. Pinsak, GLERL, NOAA, Ann Arbor, Mich.

Taylor, W.B., "Meteorological Buoy Program 1972: Statistical Summary of Buoy and Manual Measurements," CCIW Internal Memorandum. Available through CCIW and CEDDA.

Biology and Chemistry

Elder, F.C., "Preliminary Report on the IFYGL Ship Sample Intercomparison, June 1972," CCIW Internal Memorandum. Available through CCIW and CEDDA.

Robertson, A., "Preliminary Report of Chemical Results from the IFYGL Intercomparison Conducted on September 18, 1972." Available from A. Robertson, GLERL, NOAA, Ann Arbor, Mich.

Robertson, A., "Preliminary Analysis of the IFYGL Split-Sample Intercomparison." In preparation.

Winter, J., "Statistical Summaries from Second IFYGL Chemistry Interlaboratory Study," National Environmental Research Center, EPA, Cincinnati, Ohio.

NOTE: The above four studies will be incorporated into a single chemistry analysis summary to be prepared by A. Robertson, T. Davies, and F.C. Elder. It will be available through CCIW and CEDDA.

Watson, N.H.F., "Zooplankton Identification Intercomparison." Data not summarized; on file with N.H.F. Watson, CCIW.

Webber, C.I., "Intercomparison of Laboratory Analysis of Chlorophyll Concentration." Data on file with C.I. Webber, National Environmental Research Center, EPA, Cincinnati, Ohio.

<u>CANADA</u>

Editor	D.J. Phillips
Typist	Joan Atkinson

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

AES FILE: 8720-11 (ACHC)

Canadian IFYGL Centre - ACHC
Atmospheric Environment Service
4905 Dufferin Street
Downsview, Ontario
M3H 5T4
June 19, 1974

TO: IFYGL Steering Committee
IFYGL Joint Management Team
Panel Co-chairmen
Data Management Team Co-chairmen

SUBJECT: MR. D.J. PHILLIPS, NEW CANADIAN COORDINATOR

It was announced at the last meeting of the Steering Committee and the Joint Management Team that Canadian Coordinator Brian O'Donnell was leaving IFYGL to take up new duties at the Weather Office, Toronto International Airport. I am now pleased to advise that Mr. D.J. Phillips has assumed the position of Canadian Coordinator beginning June 18, 1974. The address remains the same:

Canadian IFYGL Centre - ACHC
Atmospheric Environment Service
Environment Canada
4905 Dufferin Street
Downsview, Ontario
M3H 5T4

Telephone numbers are:

D.J. Phillips, (416) 667-4955
T.L. Richards, (416) 667-4617.

Please note that all correspondence for the Canadian IFYGL Data Centre should continue to be directed to CCIW, Burlington.

Yours sincerely,

T.L. Richards

T.L. Richards
Canadian Co-chairman
IFYGL Steering Committee and
IFYGL Joint Management Team

CANADIAN PROJECT REPORTS

Note: 1. Projects are numbered consecutively.

2. The letters following the number indicate which Panel has prime responsibility for the project:

BC - Biological-Chemical
BL - Boundary Layer
EB - Energy Budget
ME - Lake Meteorology and Evaporation
TW - Terrestrial Water Balance
WM - Water Movement
F - Feasibility

Project

1F: *Remote Sensing*

Principal Investigator: K.P.B. Thompson - CCIW

This project is complete.

3WM: *Statistical Prediction of Lake Currents*

Principal Investigator: H.S. Weiler - CCIW

Last reported in Bulletin #10.

4WM: Included in Project 45WM.

5BL: *Direct Measurement of Energy Fluxes*

Principal Investigator: M. Donelan - CCIW

Last reported in Bulletin #9.

8EB: *Shore-Gauging Stations of Water Temperature*

Principal Investigator: D.G. Robertson - CCIW

Last reported in Bulletin #10.

9EB: Included in Project 42EB.

11TW: *Monthly Water Balance of the Lake Ontario Basin*

Principal Investigator: D.F. Witherspoon - IWD Cornwall

Last reported in Bulletin #9.

12TW: *Monthly Water Balance of Lake Ontario*

Principal Investigator: D.F. Witherspoon - IWD Cornwall

Last reported in Bulletin #9.

13TW: *Groundwater Flow into Lake Ontario*

Principal Investigator: D.H. Lennox - DOE, Hydrology

Completed.

14TW: *Hydrology of Lake Ontario*

Principal Investigator: E.A. MacDonald - DOE, Water Survey

Completed.

15BL: *Space Spectra in the Free Atmosphere*

Principal Investigators: G.A. McBean and E.G. Morrissey - AES

Last reported in Bulletin #9.

16ME: *Airborne Radiation Thermometer Survey*

Principal Investigator: J.G. Irbe - AES

Completed.

18ME: *Climatological Network*

Principal Investigator: J.A.W. McCulloch

Completed.

19ME: Included in Project 66ME.

20ME: *Bedford Tower Program*

Principal Investigator: J.A.W. McCulloch - AES

Last reported in Bulletin #9.

21ME: *Canadian Shoreline Network*

Principal Investigator: J.A.W. McCulloch - AES

Last reported in Bulletin #9.

22ME: *Synoptic Studies*

Principal Investigators: J.A.W. McCulloch and M.S. Webb - AES

Last reported in Bulletin #9.

23ME: *Radar Precipitation*

Principal Investigator: D.M. Pollock - AES

No report.

24ME: *Climatological Studies*

Principal Investigator: D.W. Phillips - AES

Last reported in Bulletin #10.

25ME: *Lake Ontario Evaporation by Mass Transfer*

Principal Investigator: J.G. Irbe - AES

Completed.

26ME: *Wind and Humidity Ratios*

Principal Investigator: M.S. Webb - AES

Last reported in Bulletin #9.

27ME: *Island Precipitation Network*

Principal Investigator: J.A.W. McCulloch

Last reported in Bulletin #9.

28BL: *Momentum, Heat, and Moisture Transfer*

Principal Investigators: G.A. McBean, H.C. Martin, R.J. Polavarapu - AES

Last reported in Bulletin #9.

29BL: *Space and Time Spectra*

Principal Investigators: F.B. Muller and C.D. Holtz - AES

No report.

30F: *CCGS Porte Dauphine - IFYGL - Operations*

Principal Investigator: G.K. Rodgers - CCIW

Completed.

32EB: *Thermal Bar Study*

Principal Investigator: G.K. Rodgers - CCIW

Data being analyzed.

33 Included in 32EB.

34WM: *Circulation near Toronto*

Principal Investigator: G.K. Rodgers - CCIW

Data as yet unanalyzed.

36EB: *Electronic Bathythermograph*

Principal Investigator: G.K. Rodgers - CCIW

Completed.

38TW: *Groundwater Contribution to Lake Ontario*

Principal Investigator: R.C. Ostry - OME

Reports for all the representative areas studied by the Ontario Ministry of the Environment for the IFYGL are now in press and are

listed below:

Hydrogeology of the IFYGL Oakville - Forty Mile Creeks Study Areas

Hydrogeology of the IFYGL Duffin Creek Study Area

Hydrogeology along the North Shore of Lake Ontario in the Bowmanville - Newcastle Area

Hydrogeology of the IFYGL Moira River - Wilton Creek - Thousand Islands Study Areas

Work on the investigation of remote-sensing techniques as applied to hydrologic and hydrogeologic studies in cooperation with other government and university agencies is continuing.

40WM: *Coastal Chain Study*

Principal Investigator: G.T. Csanady - University of Waterloo

Completed.

42EB: *Heat Storage of Lake Ontario*

Principal Investigator: F.M. Boyce - CCIW

Last reported in Bulletin #10.

43EB: *Internal Wave Measurements*

Principal Investigator: F.M. Boyce - CCIW

Last reported in Bulletin #10.

44BL: *Analysis of Energy Fluxes*

Principal Investigator: F.C. Elder - CCIW

Last reported in Bulletin #9.

45WM: *Lake Current Measurements*

Principal Investigator: E.B. Bennett - CCIW

Last reported in Bulletin #9.

46TW: *St. Lawrence-Niagara River Measuring Program*

Principal Investigator: E.A. MacDonald - DOE, Hydrology

Last reported in Bulletin #10.

47TW: *Computer Modelling*

Principal Investigator: L.E. Jones - University of Toronto

No report.

49TW: *Snow Stratigraphy and Distribution*

Principal Investigator: W.P. Adams - Trent University

No report.

54BC: *Groundwater Supply near Kingston*

Principal Investigator: W.A. Gorman - Queen's University

Completed.

55EB: Included in 32EB.

62ME: *Evaporation Synthesis*

Principal Investigator: J.A.W. McCulloch - AES

Last reported in Bulletin #9.

63EB: *Airborne Ice Reconnaissance*

Principal Investigator: T.B. Kilpatrick - AES

Completed.

64ME: *Basin Evapotranspiration*

Principal Investigator: H.L. Ferguson - AES

Last reported in Bulletin #9.

65ME: *Special Shoreline Evaporation Pan Network*

Principal Investigator: J.A.W. McCulloch - AES

Last reported in Bulletin #9.

66ME: *Atmospheric Water Balance Study*

Principal Investigator: H.L. Ferguson - AES

Last reported in Bulletin #9.

67ME: *Surface-Water Temperature Distribution*

Principal Investigator: M.S. Webb - AES

Last reported in Bulletin #9.

68F: *CCIW Supporting Resources*

Principal Investigator: J.P. Bruce - CCIW

Continues.

69TW: *Pleistocene Mapping*

Principal Investigator: E.P. Henderson - GSC

Last reported in Bulletin 10.

70WM: *Ground Truth for Remote Sensing*

Principal Investigator: A. Falconer - University of Guelph

Last reported in Bulletin 10.

71EB: *Canadian Radiation Network*

Principal Investigator: J.A.W. McCulloch - AES

Completed.

72EB: *Floating Ice Research*

Principal Investigator: R.O. Ramseier - DOE, Ice

Last reported in Bulletin #10.

73EB *Terrestrial Heat Flow*

Principal Investigator: A. Judge - EM&R

Last reported in Bulletin #10.

74TW: *Water Level Network*

Principal Investigator: G.C. Dohler - MSD

Last reported in Bulletin #10.

75BL: *Wind and Temperature Fluctuations*

Principal Investigators: S.D. Smith and E.G. Banke - Bedford Inst.

Completed.

76WM: *Surface Wave Studies*

Principal Investigator: G.L. Holland - MSD

Last reported in Bulletin #9.

78TW: *Basin Water Balance*

Principal Investigator: M. Sanderson - University of Windsor

Analysis of data suspended until 1975.

79F: *Bathymetric Surveys - Lake Ontario*

Principal Investigator: J.D.W. McCulloch - CCIW

Completed.

80EB: *IFYGL Radiation Balance Program*

Principal Investigator: J.A. Davies - McMaster University

This project is now complete and the Final Report has been submitted to the Data Bank. The Report is entitled "Canadian Radiation Measurements and Surface Radiation Balance Estimates for Lake Ontario during IFYGL".

81BC: *Materials Balance - Lake Ontario*

Principal Investigator: S. Salbach - OME

Last reported in Bulletin #9.

82BC: *Lake Ontario Zooplankton Migration*

Principal Investigator: J.C. Roff - University of Guelph

Last reported in Bulletin #9.

83BC: *Cooperative Studies of Fish Stocks*

Principal Investigator: W.J. Christie - OMNR

Last reported in Bulletin #9.

84BC: *Cladophora Growth*

Principal Investigator: G.W. Owen - OME

Last reported in Bulletin #9.

85BC: *Nutrient Cycles - Lake Ontario*

Principal Investigator: P. Stadelmann - CCIW

A preliminary report entitled "Phosphorous and Nitrogen Cycle on a Transect in Lake Ontario" has been completed. The introduction to this report is quoted below:

> This report is based on cruises conducted on Lake Ontario during the International Field Year for the Great Lakes 1972-73. During 9 cruises which covered one year, 32 stations were occupied and samples for biochemical analyses were taken at different depths down to the bottom of the lake (OOPS cruises). In the following presentation a transect of Lake Ontario along the 78° longitude was chosen to describe the behaviour of the lake (OOPS stations 15-22). This transect crosses the lake from North to South and may be representative for the central part of Lake Ontario. Four typical periods were chosen to display the temperature structure during deep circulation, thermal bar development, stratification and the beginning of fall overturn. The biochemical reaction of the lake during these period is best described by the inorganic nutrients such as soluble reactive phosphorus and nitrate and their conversion to organic material utilizing particulate phosphorus and particulate organic nitrogen as biomass indicators.

86BC: *Lake Ontario Surface Chlorophyll Survey*

Principal Investigator: H.F. Nicholson - CCIW

Last reported in Bulletin #9.

87EB: Included in Project 42EB.

89WM: *Turbulent Diffusion Studies*

Principal Investigator: C.R. Murthy - CCIW

Extensive report in this Bulletin.

90WM: Included in Project 89WM.

94: *Data Retransmission by Satellite*

Principal Investigator: H. MacPhail - CCIW

Complete.

95WM: *Hydrodynamical Modelling*

Principal Investigator: J. Simons - CCIW

Last reported in Bulletin #9.

96WM: Included in Project 45WM.

97BL: *Meteorological Buoy Measurements*

Principal Investigator: F.C. Elder - CCIW

Last reported in Bulletin #9.

98BC: *Lake Ontario Cross-section Study*

Principal Investigators: G. Carpenter and M. Munawar - CCIW

Last reported in Bulletin #9.

101BC: *Lake Ontario Primary Production Study*

Principal Investigators: P. Stadelmann and M. Munawar - CCIW

Three project reports have been completed and are listed below:

(1) "Primary production in relation to temperature structure, biomass concentration and light conditions at an inshore and offshore station in Lake Ontario" by P. Stadelmann, J.E. Moore and E. Pickett. (This paper will be published in T. Fish. Bd. Canada in July 1974.

(2) "Measurement and Prediction of Primary Production at an Offshore Station in Lake Ontario" by P. Stadelmann and J.E. Moore. (This report will be published as a technical report).

(3) "A Denosine-triphosphate Analysis in Lake Waters (Lake Ontario and Lake Superior) Utilizing the Luciferin-Luciferase Reaction" by P. Stadelmann. (This is a preliminary report).

102BC: *Lake Ontario Diel Pigment Variation*

Principal Investigators: W. Glooschenko and M. Munawar - CCIW

Last reported in Bulletin #10.

103BC: *Pesticide Concentration in Bird's Eggs*

Principal Investigator: M. Gilbertson - CWS

Last reported in Bulletin #9.

104BC: *Rain Quality Monitoring*

Principal Investigator: P. Stadelmann - CCIW

Last reported in Bulletin #9.

107BL: *Air Pollution Sinks*

Principal Investigator: D.M. Whelpdale - AES

Last reported in Bulletin #9.

108BL: *Lake Level Transfer*

Principal Investigator: G.C. Dohler - MSD

Completed.

109WM: *Upwelling Study*

Principal Investigator: G.K. Rodgers - CCIW

Last reported in Bulletin #9.

110WM: *Hydro Intake Study*

Principal Investigator: G.K. Rodgers - CCIW

Completed.

111WM: *Lakeview Dispersion Study*

Principal Investigator: M.D Palmer - OME

Last reported in Bulletin #9.

112BC: *Threespine Stickleback*

Principal Investigator: E.T. Garside - Dalhousie University

Last reported in Bulletin #9.

114WM: Included in Project 89WM.

115WM: *Wave Climatology*

Principal Investigator: H.K. Cho - CCIW

Full report in Bulletin #10.

116TW: *Airborne Gamma Ray Snow Survey*

Principal Investigator: H.S. Loijens - IWD, Glaciology

Last reported in Bulletin #9.

117ME: *APT Photographs*

Principal Investigator: J.A.W. McCulloch - AES

Last reported in Bulletin #10.

118:

Principal Investigators: J. Byron - CCIW

The following list of publications have been catalogued and filed within the Canadian IFYGL Data Bank, up to and including May 31, 1974.

Cat. No. CDN 3-118-001	IFYGL Technical Plan - Vol. 1
Cat. No. CDN 3-118-002	IFYGL Technical Plan - Vol. 2
Cat. No. CDN 3-118-003	IFYGL Technical Plan - Vol. 3
Cat. No. CDN 3-118-004	IFYGL Technical Plan - Vol. 4
Cat. No. CDN 3-118-005	IFYGL Bulletin - #1
Cat. No. CDN 3-118-006	IFYGL Bulletin - #2
Cat. No. CDN 3-118-007	IFYGL Bulletin - #3
Cat. No. CDN 3-118-008	IFYGL Bulletin - #4
Cat. No. CDN 3-118-009	IFYGL Bulletin - #5
Cat. No. CDN 3-118-010	IFYGL Bulletin - #6
Cat. No. CDN 3-118-011	IFYGL Bulletin - #7
Cat. No. CDN 3-118-012	IFYGL Bulletin - #8
Cat. No. CDN 3-118-013	IFYGL Bulletin - #9
Cat. No. CDN 3-118-014	"Plan of Study for the International Field Year for the Great Lakes" by S.J. Bolsenga and J. MacDowall.

DISPERSION OF FLOATABLES IN LAKE CURRENTS

(IFYGL PROJECT 89WM)

Project Team: C.R. Murthy

In recent years, the practice of dumping man-made effluents into oceanic and lacustrine waters has led to considerable interest in the study of turbulent diffusion processes in such environments. Most existing experimental evidence on turbulent transport and diffusion of effluents in the oceans and the Great Lakes refers to dissolvable substances, providing a reasonable basis for estimating effluent concentrations downstream of sources. On occasions, however, waste effluents consisting of floatables are discharged into the surface layers of the oceans and the Great Lakes. Another practically related problem is the dispersal of accidental oil spills in navigable waters. Except for some limited experimental (Csanady 1963, 1970), (Okubo and Farlow 1967) and theoretical (Okubo 1970) results, there is very little information on this practically important problem. An experiment was designed and carried out to study the dispersal mechanism of floatables in surface layer of Lake Ontario during the International Field Year for the Great Lakes as part of an overall program to study turbulent diffusion processes.

The experiment was carried out during July 18-21, 1972, 15 km offshore near Oshawa, Lake Ontario. A group of ten drogues were released in a cluster in the surface layer and the subsequent drift and spread of the drogues was followed using the ship's radar/decca navigation system. The drogue group dispersion data was quite interesting showing some striking peculiarities.

A wide variety of drogues, drift cards and drift bottles have been successfully used as tracers to measure large scale horizontal circulation and diffusion in the oceans and the Great Lakes (Csanady 1963; Okubo and Farlow 1967; Palmer 1972). In this study, roller-blind drogues were used to simulate the dispersal of floatable particles. These drogues with their large area ratio of drogue assembly to surface appendage (50:1) respond to the changes in the surrounding water movements quite well and have been used successfully for Lagrangian measurements. The drogues were calibrated in the field under a variety of wind conditions to estimate the wind drift due to surface appendage. The drift was found to be less than 1 $cm.sec^{-1}$. The use of marked drogues or similar floating objects for studying turbulent diffusion has a number of limitations. Floatables because of their density are constrained to move in a horizontal plane and respond only to the horizontal components of essentially three-dimensional flow field. Thus the drogues provide no information on vertical transport and mixing. Another limitation is the so called "filtering effect" meaning smaller scale turbulent eddies are effectively damped out due to the finite physical size of the drogues and therefore do not contribute to the turbulent transport and diffusion (Ogura 1952; Cederwall 1971). Cederwall (1971) has demonstrated the "filtering effect" in laboratory channel flow by observing the dispersal of different size drogues. Smaller size drogues would have been more suitable for this study but practical considerations in the field dictated the use of roller-blind drogues. However, to simulate the large scale horizontal

diffusion, these drogues were considered adequate, although smaller scale turbulence is averaged out due to the physical size of the drogues.

The experiment consisted of releasing a group of ten drogues set at 3m depth in a cluster of approximately 100 m or so initial size. The drift and spread of the drogue group was followed every hour for about 72 hours using the radar navigation system of the Canadian Survey Ship LIMNOS. Unfortunately, due to unforeseen field problems, there were gaps in the data. When bad weather seriously hampered the use of ship's radar navigation system for tracking the drogues, the decca navigation system was substituted, but the performance of the decca was also poor under such conditions. Some of the data was rejected for this purpose.

Temperature profiles taken from an electronic bathythermograph revealed a well developed thermocline around 5 m depth during the entire period of the experiment. Thus the drift and spread of the drogue group refers to the epilimnion.

The radar fixes were converted to displacements from which the centre of gravity of the drogue group at successive intervals of time was calculated. The drift of the drogue group constructed from the centre of gravity exhibits typical inertial loops (Figure 1). Root mean square separation of pairs of drogues, which is a measure of the group size was also calculated at successive intervals of time. A plot of the group size versus elapsed time (Figure 2) suggests periodic regrouping and subsequent dispersal of drogues at approximately 16-18 hours corresponding to the local inertial period. To explain the observed horizontal spread of drogues, one has to invoke the generation of convergence and divergence flow field by the inertial currents. Such a possibility exists when the inertial currents are modified due to the presence of the shore. For example, in the case of onshore flow, the shoreward component of the velocity must vanish at some point before reaching the shore and the water parcels must either sink or change direction or both to satisfy continuity. In any case, the net result is a convergence where floating debries collect. With an offshore flow a divergence is generated and the floatables disperse. A sloping thermocline can act much the same way as a sloping bottom and thus inducing points of convergence and divergence in the flow field. A group of floatables around a point of divergence or convergence of the velocity field either grow or shrink with time, as suggested by Okubo (1970).

The growth of horizontal variance with time derived from the dispersion of a group of floatables has been used to calculate certain diffusion parameters notably horizontal eddy diffusivity (for example Okubo and Farlow 1967). While these calculations appear to yield physically acceptable results for short term duration experiments (say 4-8 hrs), such calculations would no doubt lead to misleading results for long term experiments as the present data suggest. The convergence and divergence flow field act as anti-diffusive agents undoing the dispersive action of random turbulent eddies. The periodic shrinking and expansion of cluster of floatables contradicts our basic understanding of turbulent dispersion.

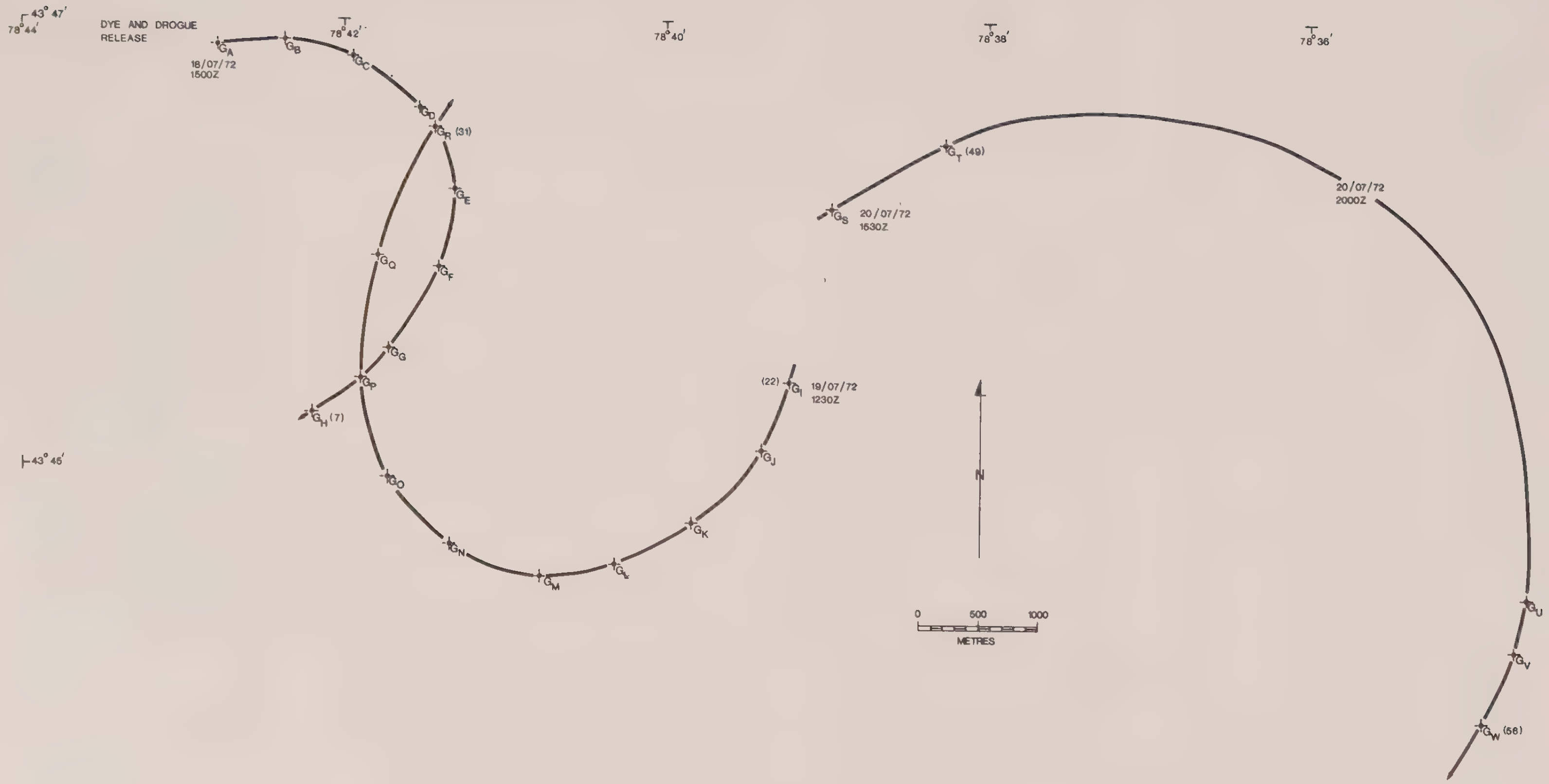

Figure 1.--Movement of centre of gravity of drogue group.

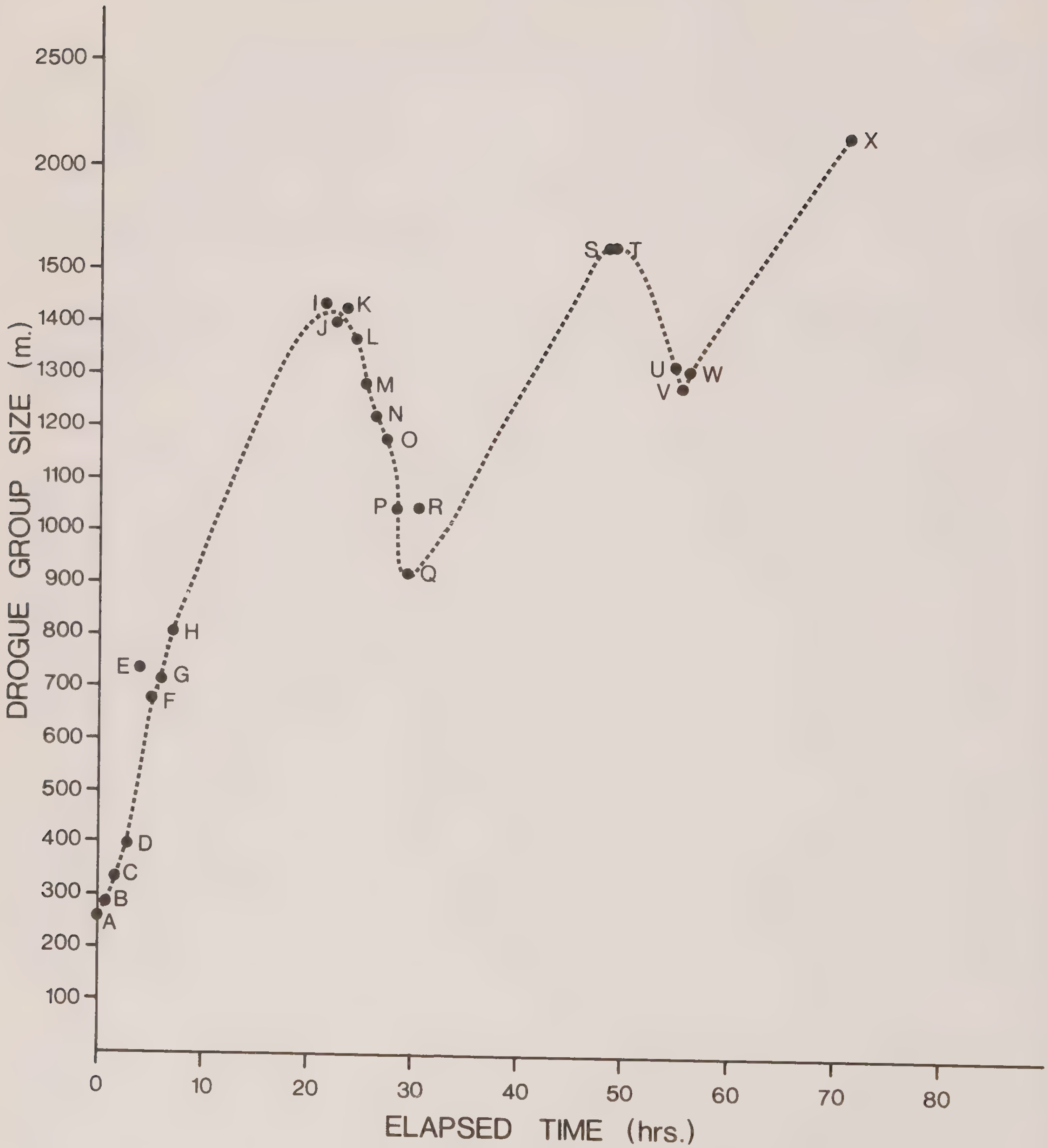

Figure 2.--Drogue group size vs elapsed time.

References

Cederwall, K. (1971). A float diffusion study. Water Research 5. pp. 889-907.

Csanady, G.T. (1963). Turbulent diffusion in Lake Huron. J. Fluid Mech. 17, pp. 360-384.

Csanady, G.T. (1970). Dispersal of effluents in the Great Lakes. Water Research, 4, pp. 79-114.

Ogura, Y. (1952). The theory of turbulent diffusion in the atmosphere. (I) J. Met. Soc. Japan 30.

Okubo, A. and J.S. Farlow. (1967). Analysis of some Great Lakes drogue studies. Proc. Tenth Conf. Great Lakes Res.

Okubo, A. (1970). Horizontal dispersion of floatable particles in the vicinity of velocity singularities such as convergences. Deep Sea Res. 17, No. 3, pp. 445-454.

Palmer, M.D. (1972). Measurement of currents in the Great Lakes. Technical Manual Series, No. 3, International Field Year for the Great Lakes.

Additional Canadian Publications on IFYGL

McCulloch, J.A.W., "The IFYGL", Hydrological Sciences Bulletin, XVIII, 1973, pp. 367-373

Frisken, W.R. and J.R. Salmon, "An objective Analysis Scheme for Surface Pressure in the Lake Ontario Basin", Proc. 16th Conference Great Lakes Research 1973, pp. 556-580

Rodgers, G.K. and G.K. Sato, "Energy Budget Study for Lake Ontario", A Canadian Meteorological Service Contribution to the IFYGL, Canadian Meteorological Research Reports, 1971, p. 22

UNITED STATES

Editors	Fred Jenkins and May Laughrun
Typing	Robert E. Massey

ERRATA

In IFYGL Bulletin No. 10, no reference was made in the Table of Contents to the "Comparison of July Temperature Statistics From Adjacent Buoys at Station 13," by R.L. Pickett and F.P. Richards, which appeared on pp. 93-94. Regrettably, the status reports on Tasks 68 and 69 were also omitted. They have been combined with the latest reports in this issue.

COMMENTS BY THE U.S. DIRECTOR

Under a NOAA reorganization directive, the U.S. IFYGL Project Office has become part of the Great Lakes Environmental Research Laboratory (GLERL), Environmental Research Laboratories, NOAA. As of early August, the address will be:

U.S. IFYGL Project Office
Great Lakes Environmental
Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, Mich. 48104

Most of the activities reported in this issue cover the period from January 1, 1974, through March 31, 1974 (fig. 1). During this period, major emphasis continued to be placed on data management, which is discussed in detail in a later section of this Bulletin. As of April 1974, the following data sets had been processed:

- The Physical Data Collection System (PDCS) Provisional Data Base for May, June, July, and October 1972.
- Provisional data for all 59 ship cruises on a 1-s cycle.
- Provisional rawinsonde data for two 6-day periods.

Corrected DECCA and geographic positions have been determined for all PDCS stations, time-series graphics and microfilm plots of the 1-s averages are being generated for all ship cruises, and rawinsonde error analysis is proceeding.

IFYGL Technical Manual No. 5, "U.S. IFYGL Shipboard Data Acquisition System," was printed in March. Requests for copies should be addressed to the U.S. IFYGL Project Office in Ann Arbor, Mich.

Planning is continuing for the IFYGL Scientific Report series. At a meeting of the Joint Management Team on April 8, 1974, draft outlines were presented for reports on the Terrestrial Water Budget, Lake Meteorology, Energy Balance, and Atmospheric Boundary Layer.

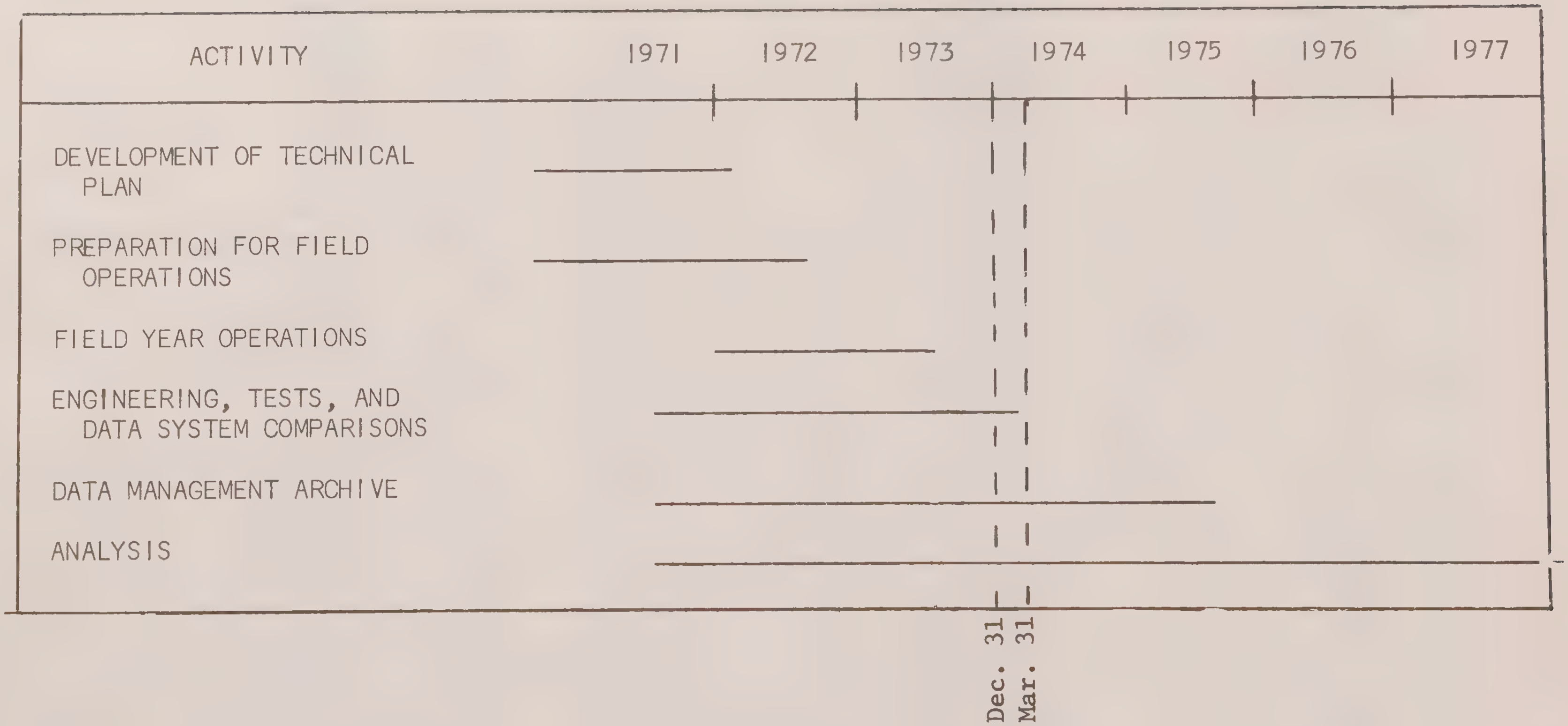

Figure 1.--U.S. IFYGL schedule.

U.S. SCIENTIFIC PROGRAM

Based upon reports requested by the U.S. IFYGL Project Office, the progress from January 1 through March 31, 1974, is presented for each of the U.S. IFYGL tasks. Some reports cover work done in April 1974.

Panel activity status reports follow the task reports.

Tasks

1. *Phosphorus Release and Uptake by Lake Ontario Sediments*

Principal Investigators: D.E. Armstrong and R.F. Harris - University of Wisconsin

Desorption has been studied through successive equilibrations of sediment in a 0.1 M NaCl solution under a nitrogen atmosphere. Sediments from the central basin stations were found to desorb more inorganic P than those from the inshore zone. Sediments desorbed less inorganic P under oxic than under anoxic conditions. Sufficient inorganic P was desorbed after each equilibration to maintain a large portion of the original equilibrium inorganic P values. The total P, total inorganic P, and total organic P values at stations 14, 41, and at the mouth of the Genesee River were generally lower than at the central basin stations, and there were small amounts of NaOH-P and CDP-P but a high proportion of HCl-P (immobile). The sediment P values for the above stations were in agreement with values for other inshore stations. Evaluation of experimental results of this and other phases of the research in preparation for publication was continued.

2. *Net Radiation*

Principal Investigator: M.A. Atwater - CEM

Work on developing a technique for analyzing or diagnosing fog layers over Lake Ontario from April through June 1973 was completed. A previous analysis of the frequency of fog over the lake in 1972 had shown that the most significant problem occurred during the spring. The analysis included the following:

(a) Comparison of visibility reports from land stations and research ships between May and November 1972.

(b) Analysis of variables to diagnose fog from May to June 1972.

(c) Preparation of fog indicator based on all ship reports (IFYGL research ships and other passing vessels), land station data, and other information.

The comparison of land station and ship visibility reports was subject to several constraints. At the time of the study, only U.S. research ship reports were available to us. Also, ships report visibility by category, while land stations can report visibility to the nearest mile or less. The analysis indicated that during periods of generally low visibility at land stations one can expect even lower visibilities over the lake, i.e., the average ship-land visibility ratio is 0.75. However, the relationship between the two visibilities is not linear, since during periods of generally poor visibility over the lake (an average ship visibility of 2 mi or less), the ratio drops to 0.4. Visibility reports from land stations are not by themselves sufficient to determine the likelihood of lake fog.

Following the above initial evaluation, plans were to proceed on developing a decision-tree technique to diagnose fog for those days when ship observations were not available. In the meantime, shipboard meteorological observations for 1972 were received from CEDDA. These data, consisting of reports from both the IFYGL research ships and other passing vessels, when combined with data already on hand were judged sufficient for direct specification of fog and no-fog conditions over the lake. Specification was done on a 3-hourly basis from April 1 through June 30, 1972. The fog specification is believed to be highly reliable for almost every day in May and June 1972 and reasonably so for April 1972.

The following NOAA-2 satellite data were received in early March 1974: very high resolution radiometer (VHRR) data for many dates from December 10, 1972, to March 31, 1973; and scanning radiometer (SR) data for many dates between November 18 and December 31, 1972.

The NOAA-2 VHRR pictures were judged to be much more useful than either the NOAA-2 SR data or the ESSA-9 ADVCS data received earlier. All NOAA-2 VHRR pictures were reviewed, and such problems as picture quality or difficulty in feature location were noted. (The pictures are not gridded.) The satellite data for February 23 to 28, 1973, were used in studying how such data can be used to verify or modify cloud analyses based on surface observations alone.

No work was done on the radiation model because of delay in arrival of data. Data have now been received from the United States IFYGL Data Center and from John Davies in Canada. Work on the model is proceeding.

3. *RFF/DC-6 Boundary Layer Fluxes*

Principal Investigator: B.R. Bean - ERL/NOAA

Selected days for each alert period were analyzed, and a preliminary report was presented to the U.S. IFYGL Project Office staff.

Most of the evaporation during the year occurs in the fall and is closely associated with outbreaks of polar continental air. Such outbreaks have a pronounced effect on the evaporation dynamics of the lake and are

characterized by cold, dry air moving down from Canada across the lake at sustained windspeeds of the order of 12 to 15 ms^{-1} at the 30-m level above the lake surface. Such an event occurred on October 9, 1972. The wind direction at the 30-m level above the lake surface was constant and from the northwest. The airspeed for the day averaged 13 ms^{-1}. The most pronounced effect of the outbreak was the reduction of the air temperature at 30 m, ultimately reaching half of the surface value. While the "normal" evaporation rate for October is close to 0.3 cm day^{-1}, this rate almost quadrupled during the outbreak. The measured evaporation rate at the 30-m level was 0.48 cm day^{-1} at the north side ($\sim$ 10 km from the shore), 0.92 cm day^{-1} at the center, and 1.34 cm day^{-1} at the south side of the lake.

Surface temperatures obtained with the airborne downward-pointing IR system showed a 10-km-wide band of water along the north shore with a surface temperature of $\sim 5^{\circ}C$; elsewhere on the lake, the surface temperature was $\sim 14^{\circ}C$. The induced drag on the lake surface caused by the persistent strong winds seems to result in upwelling currents along the north shore. Also, it was found that the convergence zone between the cold upwelling water and the warm surface water 10 km south of Cobourg corresponds to a sudden increase in the depth gradient of the lake.

The spectra of the water-vapor flux demonstrate clearly the tendency for the peak value to march to lower frequencies with increasing height. This implies that, although the small-scale eddies contribute more to the flux of water vapor near the surface, this effect tends to be transferred to ever larger eddies with increasing height above the surface. Plotting the maximum wavelength of the spectra vs. height on log-log paper yields a linear relationship, with a slope of $\sim$ 0.7 and intercept of $\sim$ 110 at a height of 10 m, confirming the results obtained from BOMEX data (Bean, B.R., R. Gilmer, R.L. Grossman, and R. McGavin, "An Analysis of Airborne Measurements of Vertical Water Vapor Flux During BOMEX," Journal of Atmospheric Sciences, Vol. 29, No. 5, 1972, pp. 860-869).

Plans for the next quarter include preparation of a data report on all data analyzed for each alert period.

4. *Nitrogen Fixation*

Principal Investigator: R. Burris - University of Wisconsin

Task completed.

5. *Profile Mast and Tower Program*

Principal Investigator: J.A. Businger - University of Washington

Data from our Cobourg station obtained on 1/4-in magnetic tapes with a frequency shift key system and voltage control oscillator backup have been placed on standard seven-track computer tapes. On some of these tapes data points are missing, but these omissions constitute less than 0.01 percent of

the data in the worst cases. The missed points are being interpolated, and when this has been done the data will be checked against the strip charts for general quality and compared numerically with data from the Canadian Atmospheric Environment Service (AES) shore station at Cobourg.

Strip charts of our Rochester data are being examined for general quality, and the data will be compared numerically with data from tower 27, which was near our tower.

6. *Status of Lake Ontario Fish Populations*

Principal Investigator: J.H. Kutkuhn - Great Lakes Fisheries Laboratory

A paper on this task, with W.J. Christie of Canada as coauthor, was presented at the IFYGL Symposium, Fifty-Fifth Annual Meeting of the American Geophysical Union, Washington, D. C. on April 8, 1974.

7. *Material Balance of Lake Ontario*

Principal Investigator: D.J. Casey - EPA

No report.

8. *Runoff*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

Work completed.

9. *Evaporation (Lake-Land)*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

First-cut estimates of monthly evaporation from the lake for the Field Year have been completed. As more refined data become available from other investigators, final estimates will be made.

10. *Simulation Studies and Analyses Associated With the Terrestrial Water Balance*

Principal Investigator: B.G. DeCooke - U.S. Army Corps of Engineers

Activity has not begun.

11. *Land Precipitation Data Analysis*

Principal Investigators: L.T. Schutze and R. Wilshaw - U.S. Army Corps of Engineers

No progress was made during this quarter. Awaiting data from other investigators.

12. *Transport Processes Within the Rochester Embayment of Lake Ontario*

Principal Investigator: W.H. Diment - University of Rochester

No report.

13. *Soil Moisture and Snow Hydrology*

Principal Investigator: W.N. Embree - U.S. Geological Survey

Complete report filed with the U.S. Cochairman of the Terrestrial Water Balance Panel.

14. *Boundary Layer Structure and Mesoscale Circulation*

Principal Investigator: M.A. Estoque - University of Miami

See Task 15 below.

15. *Mesoscale Simulation Studies*

Principal Investigator: M.A. Estoque - University of Miami

Work during the quarter was concerned primarily with numerical modeling. Several additional simulations of the lake breeze have been made with the two-dimensional model to determine the sensitivity of lake-breeze intensity to the amplitude of the land-lake surface temperature contrast. One interesting result is the formation of a lake breeze that occurs only offshore and does not reach the coastline. In establishing initial conditions for the three-dimensional model, not much progress has been made in solving a problem that involves the excitation of what appears to be a spurious wave at upper levels. This problem is being analyzed with a linearized version of the model.

Early in the next quarter, our aim is to resume and complete analysis of lake breezes based on data obtained during the intensive observation periods in June and October 1972. Numerical modeling work will be done during the latter part of the quarter at NCAR.

16. *Lake Level Transfer Across Large Lake*

Principal Investigator: C.B. Feldscher - LSC/NOAA

Reduction of station pressure to lake level at Rochester and Toronto has been completed in the form of tabulated data and plotted graphs. Wind data were reduced to eight selected directions to determine the effect of wind only. As soon as personnel becomes available, plans are to compare wind and barometric pressure effects on water levels, with the objective of testing computed correction factors and compensating for these effects during periods when water transfers occurred.

17. *Nearshore Ice Formation, Growth, and Decay*

Principal Investigator: A. Pavlak and J. Dilley[1] - General Electric Company

The following report covers the period from October 1973 through March 1974.

A magnetic tape documenting 90,000 data points acquired during the Field Year was sent to CEDDA for archiving. Arrangements are being made for transmitting an archivable copy of "IFYGL Near Shore Ice Formation, Growth, and Decay - Comprehensive Phase I Summary." The Energy Balance Workshop was attended on October 17, and an abstract was submitted for presentation at the IAGLR 17th Annual Conference, August 12-14, 1974, Hamilton, Canada.

The time-lapse camera was deployed, and the following supplemental data were acquired from other sources: longwave, shortwave, incident, reflected, and net radiation data (M. Atwater, CEM); wind velocity, wind direction, air temperature, barometric pressure, precipitation, and dewpoint data (IFYGL station 29); surface water temperature and offshore ice coverage data (G. Irbe, AES, Canada); evaporation pan data (C. Hoffeditz, NWS, NOAA); and basic data for the Oswego coastal chain (J. Scott, State University of New York at Albany). A large part of these data has been analyzed and compared with our 1972-73 field data. Some of the more recent acquisitions remain to be analyzed.

The following estimates of thermal properties of the nearshore soil at Nine Mile Point have been made from on-site observations: specific heat, 0.20 cal/g/$^{\circ}$C; soil porosity, 30 percent; dry density, 1.85 g/cc. Based on these values, thermal conductivity varies with moisture content from 1.2 to 5.6×10^{-3} cal/cm/s/$^{\circ}$C and thermal diffusivity from 3.4 to 15.0×10^{-3} cm^2/s. Thermal diffusivity has also been computed from analysis of ground-probe data by means of the one-dimensional heat conduction equation. For probe G2, the mean thermal diffusivity was found to be 7.0×10^{-3} cm^2/s.

Detailed analysis of offshore thermistor data and correlation with other data have yielded the following significant preliminary results:

(a) No consistent offshore temperature gradients, either vertical or horizontal, have been observed.

(b) Large temperature changes correlate well with changes in wind direction. This and other findings lead to the suggestion that advective heat fluxes are most significant.

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[1] J. Dilley has been added as Coprincipal Investigator on this task.

(c) The thermal plume from the Nine Mile Point nuclear power station, located 1 mi east of the field site, has been observed during periods of easterly winds. Temperature jumps of up to 6°C have been correlated with these events.

(d) Detailed analysis of the second ice formation phase leads to the preliminary conclusion that ice was formed within a shoreline band 500 m wide and that heat loss from the lake was of the order of 20 $cal/cm^2/hr$.

(e) During the storm of January 6, 1973, that caused the second ice formation phase, the water-air heat transfer coefficient was preliminarily estimated at 10 $cal/cm^2/°C/hr$.

(f) In the absence of the powerplant thermal plume, measured lake water temperatures correlate surprisingly well with nearshore water surface temperatures acquired by Canadian aircraft.

The above results have revised our view of the thermal structure of the nearshore lake. The lake water is by no means quiescent, even when the surface is calm. Nearshore currents are very responsive to winds. The nearshore lake is well mixed by currents and surface waves and is essentially isothermal, which complicates the modeling work since variable eddy conductivities must be used. Original plans for the thermistor transients should be redirected toward efforts to improve the model, and contractual assistance is being requested for these efforts.

The numerical model that will be used to analyze in detail the heat transfer during shore ice formation, growth, and decay at Nine Mile Point, and later around the lake, is being developed step by step. The first steps of assembling information on earlier studies, on suitable numerical techniques, on environmental heat transfer, and on material thermal properties have been completed. A special numerical scheme for integrating the two-dimensional, time-dependent heat conduction has been derived. It is a mixed implicit/explicit scheme: implicit in the vertical to allow for smaller grid spacing near the surface and explicit in the horizontal to reduce execution time. The technique has been programed, debugged, and checked against a known analytical solution to a simple two-dimensional transient problem. The next steps of including the phase change and the intermaterial boundaries, and adding the surface heat transfer conditions are in progress.

18. *Advection Term - Energy Balance*

Principal Investigator: J. Grumblatt - LSC/NOAA

No report.

19. *Occurrence and Transport of Nutrients and Hazardous Polluting Substances in the Genesee River Basin*

Principal Investigator: L.J. Hetling - New York State Department of Environmental Conservation

No report.

20. *Boundary Layer Flux Synthesis*

Principal Investigators: J.A. Almazan and J.K.S. Ching - CEDDA/NOAA

Further tests of applying the orthogonal objective analysis scheme to the United States and Canadian meteorological buoy data for July 1972 have been made. In addition to the derivations of windspeed, temperature, and moisture fields computed earlier, crossproducts of windspeed with (a) wind component, (b) air-lake temperature difference, and (c) air-lake moisture difference have been obtained. Application of the objective analysis technique to the flux estimates of momentum, heat, and water vapor obtained from these crossproducts via the bulk aerodynamic method will be studied during the next quarter.

Vorticity and divergence of the measured winds have also been computed with the objective analysis technique. The results agree well with the wind component study of the lake-land breeze reported in IFYGL Bulletin No. 8.

Plans for the next quarter include an intercomparison study of the data from the United States and Canadian buoys at station 13.

21. *Hazardous Material Flow*

Principal Investigator: T. Davies - EPA

No report.

22. *Remote Measurement of Chlorophyll With Lidar Fluorescent System*

Principal Investigator: H.H. Kim - NASA

No report.

23. *Inflow/Outflow Term - Terrestrial Water Budget*

Principal Investigator: P.L. Cox[2] - U.S. Army Corps of Engineers

Work on the outflow term has been completed, and the final report submitted to the U.S. IFYGL Data Center. Work is progressing on the inflow term.

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[2] P.L. Cox has replaced I.M. Korkigian as Principal Investigator on this task.

24. *Use of an Unsteady State Flow Model To Compute Continuous Flow*

Principal Investigator: P.L. Cox[3] - U.S. Army Corps of Engineers

No progress.

25. *Radiant Power, Temperature, and Water Vapor Profiles Over Lake Ontario*

Principal Investigator: P.M. Kuhn - ERL/NOAA

Work completed.

26. *Algal Nutrient Availability and Limitation in Lake Ontario*

Principal Investigator: G.F. Lee - University of Texas at Dallas

No report.

27. *Wave Studies*

Principal Investigator: P.C. Liu - LSC/NOAA

Processing and analysis of recorded wave data from the four wave riders during the Field Year have been progressing. The data recorded on analog magnetic tapes are digitized by an A/D converter, a device peripheral to the Sigma III computer. Computer processing of the digitized magnetic tapes includes editing, calibration, time correlation, analyses, and generation of reports. Data reports are generated for each analog tape, consisting of hourly statistics of average, significant, and highest 1/10 wave heights and corresponding wave periods. These reports can be used both as an index to the digital tapes and for statistical analyses and study of frequency of occurrence. The digital data can also be used for spectral analyses for selected storm periods. Of the wave data, 75 percent have been processed. A paper entitled "Duration-Limited Wave Spectra in Lake Ontario" has been submitted for presentation at the IAGLR 17th Annual Conference in August.

28. *Cloud Climatology*

Principal Investigator: W.A. Lyons - University of Wisconsin, Milwaukee

Manual analysis of the solarimeter charts obtained at Hamilton Beach and Rome, N.Y., is progressing. We hope to publish soon an hour-by-hour listing of insolation values at these two points to complement the Canadian data. Acquisition of Air Force Data Acquisition and Processing Program (DAPP) imagery of the Great Lakes continues for use in cloud climatological analyses. We are waiting for large amounts of data requested from CEDDA and other sources.

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[3] P.L. Cox has replaced I.M. Korkigian as Principal Investigator on this task.

After much study, we have found no adequate commercially available system for viewing the many types of images we have for photogrammetric purposes. We have therefore designed a multiformat image-viewing system, consisting of a combination of projectors, mirrors, and working surface so that images can be viewed and calculations made from the 16-mm, 35-mm (strips and slides), and 70-mm data acquired. It is hoped that all components will be available for assembly in May 1974. Manual analysis of the solarimeter charts should be completed shortly, but publication of final values may be delayed somewhat because of the necessity for rechecking instrument calibrations. A list of ERTS, DAPP, and 35-mm and 16-mm all-sky fisheye imagery will be prepared to supplement the already available panoramic photographs from the IFYGL ships.

29. *Zooplankton Production in Lake Ontario as Influenced by Environmental Perturbations*

Principal Investigator: D.C. McNaught - State University of New York at Albany

No report.

30. *Change in Lake Storage Term - Terrestrial Water Budget*

Principal Investigator: R. Wilshaw - U.S. Army Corps of Engineers

Computer programming has been completed, and data processing has begun. Results should be available shortly.

31. *Soil Moisture*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

No progress.

32. *Testing of COE (Corps of Engineers) Lake Levels Model*

Principal Investigator: E. Megerian - U.S. Army Corps of Engineers

This task has been canceled.

33. *Nearshore Study of Eastern Lake Ontario*

Principal Investigator: R.B. Moore - State University of New York at Oswego

No report.

34. *Internal Waves - Transects Program - Interpretation of Whole-Basin Oscillations*

Principal Investigator: C.H. Mortimer - University of Wisconsin, Milwaukee

The plotted temperature transects referred to in IFYGL Bulletin No. 9 have been revised and are being redrawn for the final report, "Lake Ontario Temperature Transects Continuously Repeated." This has taken longer than expected because of the policy of identifying each data point (a total of approximately 24,000 circles) rather than relying on interpolated contours only. Calibration checks and comparison with the data listed under (b) and (c) in the IFYGL Bulletin No. 9 progress report are also time-consuming, but I have insisted that the data be fully edited before the final report is issued.

A paper on internal waves entitled "The Internal Wave Response of the Lake Ontario Thermocline to the Passage of a Storm, 9-10 August 1972," was presented at the IFYGL Symposium, AGU meeting, in April. Coauthor was D.L. Cutchin, not F.M. Boyce as stated in IFYGL Bulletin No. 10.

35. Pontoporeia affinis *and Other Benthos in Lake Ontario*

Principal Investigator: S.C. Mosley - University of Michigan

An extensive report on this task was contained in IFYGL Bulletin No. 10.

36. *Pan Evaporation Project*

Principal Investigators: C.N. Hoffeditz - NWS/NOAA
J.A.W. McCulloch - AES, Canada[4]

Consistency checks of the data from the Canadian stations have been completed. Additional data, consisting of shortwave and total hemispheric radiation data, from these stations will be made available. In a coordination meeting, the two principal investigators agreed on joint analysis of the data for comparative purposes. Other coordination meetings are planned to further analyze the evaporation station data. Primary emphasis will be placed as of now on shallow-lake evaporation computations for the Canadian stations. The only current problem is the lack of PDCS data from the United States stations.

37. *Simulation Studies and Other Analyses Associated With U.S. Water Movements Projects*

Principal Investigators: J.P. Pandolfo and C.A. Jacobs - CEM

A series of computations were added to the three-dimensional model as a direct check on the water balance within Lake Ontario, as well as an indirect check on the logic of the program. Programming errors discovered as a result

[4] This is a joint United States-Canadian task.

of this work have been corrected, and several preliminary simulations have been run based on climatology data for July 1972. After discussions with J. Bennett in February 1974, the results of these preliminary simulations were scrutinized for two grid interval waves in the solutions for the water elevations. The waves were not found under inflow and outflow boundary conditions that correspond to actual observations, but appeared under conditions of extreme, unrealistically large inflows and outflows.

Simulations with the second, rigid-lid, version of the model is underway, and the results of these simulations are the primary ones expected during the next quarter.

38. *Structure of Turbulence*

Principal Investigator: H.A. Panofsky - Pennsylvania State University

Work completed on the relation between coherence and the angle between the wind and the anemometer showed that Taylor's hypothesis was not quite adequate to explain phase delays. It was found that large eddies travel with a speed greater than the local wind because their center of gravity is located above the point of measurement, an effect that has also been noted in wind tunnel tests. A paper describing the properties of slant and vertical coherence has been prepared in draft form.

Ratios of standard deviation of vertical velocity to friction velocity over land and water have been obtained and are being analyzed as a function of Richardson number to determine whether there are any significant differences over land and water. So far none have been found. A relatively simple equation seems to fit all data fairly well and will lead to methods for calculating diffusion parameters, which will differ over land and water because of the difference in roughness.

A paper is being prepared that describes fluctuations of the wind component at the buoys over periods of about 1 hr. A theory linking coherence with Lagrangian statistics, useful for diffusion estimates, has been developed and will be presented at the AMS/WMO Symposium on Atmospheric Diffusion and Air Pollution in Santa Barbara, Calif., September 9-13, 1974.

39. *Airborne Snow Reconnaissance*

Principal Investigator: E.L. Peck - NWS/NOAA

A draft of the final report has been prepared.

40. *Optical Properties of Lake Ontario*

Principal Investigator: K.R. Piech - Calspan Corporation

Data reduction was completed during the quarter. The final steps consisted of analyzing several aircraft flights on which difficult atmospheric or illumination conditions were encountered. An improved technique for obtaining the ratio of blue-to-green reflectance was developed and applied to

all the aerial imagery. The resulting lakewide average values are listed in table 1. The method used earlier for obtaining reflectance ratios was based on ground measurements of the reflectances of selected targets at the endpoints of each flight track. In practice, it proved difficult to fly over the same endpoints on each flight, and the ground measurements of the targets made it necessary to cover some 30 widely separated sampling locations. Only a few targets could be sampled within each location because of time constraints, affecting the accuracy of the final photometric calibration. The technique now used for obtaining blue-to-green reflectance ratios does not require ground target sampling at the endpoints of the flight track, and a much larger number of targets is therefore available for final photometric calibration.

The correlation between the various surface optical data (table 1) and between these data and the chlorophyll samples has been noted in earlier reports. Data from flights during the cruise periods beginning on July 10, August 21, and September 11, 1972, indicated correlation with surface data, but additional information was necessary as confirmation. The temporal variation based on analysis of new data for the periods beginning on June 12 and October 16 agree surprisingly well with the variation of the other data. The ratio of blue-to-green lake reflectance shows a strong decrease with increasing lake turbidity and chlorophyll content.

The relationship between reflectance ratio and chlorophyll concentration should not be considered unique, because turbidity variations of other origin also modify the ratio value. We have begun to use solutions to the radiative transport equation to investigate these relationships more thoroughly. For example, the blue-to-green reflectance ratio of a body with optical constants approximating those of distilled water would be ~ 4.5. Experimental data from ocean water with very low chlorophyll content yield a value of ~ 4.0, and extrapolation of the data in table 1 gives a zero chlorophyll value of ~ 3.5. Addition of 1 mg/m^3 of chlorophyll to the model distilled water medium reduces the blue-to-green ratio to ~ 1.5. However, addition of "grey" scattering and absorption coefficients of $\sim 0.1\ m^{-1}$ also decreases this ratio to the same range (~ 1.3). The absolute level of reflectance for this more turbid medium is about a factor or two higher than for the medium with the chlorophyll. Care must therefore be taken in transferring the ratio-concentration relationships shown in table 1 to other lakes with different turbidities. The same is true in interpreting the relationships between the aerial data and the surface optical data. During the next reporting period, we hope to comment more definitively on these relationships and include comparisons of data over various regions of the lake.

41. *Storage Term - Energy Balance Program*

<u>Principal Investigator</u>: A.P. Pinsak - LSC/NOAA

No report.

Table 1.--Lakewide average of optical parameters

Parameter		Cruise week May 1	May 25	June 12	July 10	Aug. 21	Sept. 11	Oct. 16	Oct. 29	Nov. 27
Secchi disk transparency (m)[1]		4.2	5.8	5.7	4.0	3.0	3.8	5.4	6.4	--
Attenuation coefficient (m^{-1})		1.32	1.56	1.51	1.90	1.93	1.45	1.28	0.78	1.15
1 percent relative irradiance level (m)	Red	--	3.3	4.9	4.4	3.9	3.8	5.1	5.3	--
	Green	--	7.5	8.8	7.2	6.2	7.0	10.4	10.4	--
	Blue	--	5.5	6.4	4.3	3.8	4.3	6.3	6.7	--
Reflectance ratio[1]	Blue/Green	--	--	1.8	1.6	1.3	1.8	2.7	--	--
Chlorophyll[1,2] (mg/m^3)		--	3.8	6.9	7.4	--	7.2	2.9	--	1.4

[1] Values from stations where other optical measurements were made.

[2] Average of samples taken at 1- and 5-m depths. Data supplied by Canada Centre for Inland Waters.

42. *Sensible and Latent Heat Flux*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

43. *Thermal Characteristics of Lake Ontario and Advection Within the Lake*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

44. *Oswego Harbor Studies*

Principal Investigator: G.L. Bell - LSC/NOAA

Report preparation continues covering the periods of investigation and parameters outlined in IFYGL Bulletin 9, pp. 58-60.

The rapid, easily applied test of specific conductance to trace riverwater movement through the harbor and area of diffusion showed that ion concentrations were relatively high in the river and harbor compared with the lake background levels. The degree of dilution within the harbor is largely dependent upon the volume of riverflow and the temperature differential between the two bodies of water. In general, periods of greatest dilution within the harbor were found to correlate with low riverflow. Cooling water obtained from the lake and discharged by the Niagara Mohawk Steam Station into the western end of the harbor tends to keep the adjacent portion of the harbor warmer and less turbid, and provides a flushing action. During spring and summer the relatively warmer plume spreads over the cooler lake water. During late summer and fall the relatively cooler riverwater plunges beneath the lake surface at or near the harbor entrance. The influx of turbid riverwater produced low water transparency throughout the river and harbor, with Secchi disk readings of less than 1 m in most cases. Light transmission over a 1-m path was not usually detectable by transmissometer throughout most of the harbor. Transparency profiles were found to be an effective means of tracing the harbor plume when it plunges below the lake surface. The plume responds to changes in wind direction and to shifts in the longshore current. The prevailing current direction is northeastward, but periods of northward and westward flows were observed. The detached breakwater split the plume into northward and shoreward components during prevailing conditions, leaving a "pod" of Lake Ontario water in the lee. A comparison of the mean specific conductance of the riverwater and lake background shows that 85 to 90 percent dilution occurs within 1.5 mi north-northeast of the harbor entrance and within 2 mi to the northeast, along the shore.

Relatively small amounts of sediment, often less than 1 in thick, were found overlying bedrock outside the harbor. Apparently the combined effects of the alongshore and wave-generated currents coupled with the character and

volume of source sediments tend to keep the bedrock surface of the lake bottom relatively clean adjacent to the harbor.

The results of total coliform tests made during 11 cruises are given in table 2. Samples collected near the surface and above the sediment-water interface show variations in both vertical and areal distributions. High counts were common in the river, at the west end of the harbor, and east of the harbor entrance.

Preparation of a report on the studies outlined in IFYGL Bulletin No. 9 continues.

45. *Mapping of Standing Water and Terrain Conditions With Remote Sensor Data*

Principal Investigator: F.C. Polcyn - ERIM[5]

ERTS multispectral sensor (MSS) data of the Lake Ontario basin, consisting of portions of eight ERTS frames, have been processed for recognition of selected terrain classes. These data were dark-level corrected before processing, as described in earlier reports. The recognition processing was done with the Spectral Analysis and Recognition Computer (SPARC) system. This prototype special-purpose high-speed system is capable of performing likelihood-ratio decision processing with up to 12 spectral bands of data at a rate of 10,000 decisions per second. After initial selection of appropriate decision criteria, about 1 hr was required to produce a single recognition image of the basin with the SPARC. Much of this time was spent on manual tape editing and recording of digital counts for area determination. Ten recognition images, representing various terrain features, were produced.

The first step in the decision process was to level slice the near-IR ERTS band 7 for recognition of surface water. With water areas designated by this level slice, all subsequent processing was done on the remaining "non-water" data. Input to the second step were ratios of ERTS bands 5 and 6 and bands 5 and 7. Analysis indicated correlation coefficients between these two ERTS ratios of 0.996. The likelihood-ratio decision rule applied to these two ratios therefore probably accomplished little more than level-slicing of the IR-red ratio.

Preliminary analysis of the recognition results has dealt with the westernmost part of the basin, for which extensive ground observations and supporting aircraft imagery are available. Two color-coded composite recognition images for a 35-km by 65-km area in Ontario between Hamilton and Toronto were prepared at a scale of approximately 1:300,000. The area includes the cities of Burlington, Oakville, Port Credit, Brampton, and the east and middle Oakville representative basin, which covers 21,000 ha and is the site of an IFYGL hydrological study by the Ontario Ministry of the Environment. Compies of the color-coded images are contained in the January-February bimonthly report to the NASA Goddard Space Flight Center under contract NA55-21783.

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[5] Affiliation has been changed to the Environmental Research Institute of Michigan (ERIM).

Table 2.--Total coliform count, Oswego Harbor

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
2	1	1	400
"	"	"	360
"	"	"	100
"	4	"	2,100
"	4	"	1,300
"	6	"	0
"	7	"	500
"	10	"	100
"	18	"	0
"	19	"	400
"	21	"	2,400
"	32	"	11,000
"	33	"	1,400
"	34	"	400
3	1	1	900
"	10	"	1,120
"	18	"	20
"	34	"	1,120
"	37	"	4,100
4	3	1	1,900
"	5	"	1,300
"	6	"	1,480
"	7	"	740
"	12	"	0
"	16	"	20
"	16	"	20
"	25	"	460
"	32	"	2,800
"	37	"	8,600
5	1	1	900
"	7	"	500
"	11	"	800
"	12	"	40
"	13	"	40
"	15	"	0
"	18	"	0

Table 2.--Total coliform count, Oswego Harbor (continued)

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
5	22	1	1,100
"	22	"	480
"	25	"	200
"	34	"	200
"	37	"	3,400
13	1	5	16,800
"	5	"	11,500
"	7	"	27,300
"	9	"	3,290
"	18	"	46,200
"	22	"	1,460
"	25	"	1,550
"	29	"	1,500
"	32	"	4,860
"	34	"	200
"	35	"	2,120
"	37	"	4,040
18	1	1	4,500
"	"	4	10,100
"	3	1	11,300
"	"	7	34,500
"	4	1	3,400
"	"	7	2,500
"	5	1	3,900
"	"	4	5,000
"	7	1	6,500
"	"	8	2,700
"	8	1	500
"	"	7	400
"	10	1	3,500
"	"	8	400
"	20	1	0
"	"	7	200
"	22	1	0
"	"	3	600
"	29	1	200
"	"	8	1,200
"	32	1	200
"	"	4	700
"	34	1	0

Table 2.--Total coliform count, Oswego Harbor (continued)

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
18	34	13	300
"	37	1	6,000
"	"	6	4,900
"	38	1	1,000
"	"	4	300
22	1	1	380
"	"	13	680
"	"	1	820
"	3	"	300
"	"	20	440
"	4	1	620
"	"	20	440
"	5	1	600
"	"	16	1,520
"	6	1	920
"	"	20	1,460
"	28	1	1,080
"	"	16	380
"	36	1	1,960
"	"	20	1,940
"	37	1	1,820
"	"	20	2,800
26	1	1	2,600
"	"	13	2,540
"	3	1	1,720
"	"	23	1,900
"	4	1	2,060
"	"	23	2,000
"	5	1	1,480
"	"	16	1,940
"	6	1	680
"	"	23	620
"	7	1	540
"	"	26	580
"	8	1	260
"	"	23	620
"	9	1	20
"	"	26	0
"	10	1	0

Table 2.--Total coliform count, Oswego Harbor (continued)

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
26	10	30	20
"	11	1	240
"	"	23	320
"	12	1	0
"	"	26	60
"	13	1	40
"	"	26	20
"	19	1	100
"	"	46	120
"	20	1	40
"	"	20	640
"	22	1	380
"	"	13	420
"	28	1	2,500
"	"	20	2,120
"	29	1	20
"	"	26	0
"	30	1	80
"	"	33	140
"	32	1	360
"	"	13	300
"	37	1	2,160
"	"	20	2,560
"	44	1	300
"	"	30	320
"	45	1	400
"	"	20	480
29	1	1	16,800
"	"	13	21,000
"	3	1	12,400
"	"	23	23,600
"	4	1	19,400
"	"	23	15,100
"	5	1	6,100
"	"	13	11,900
"	6	1	6,000
"	"	23	13,200
"	7	1	8,200

Table 2.--Total coliform count, Oswego Harbor (continued)

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
29	7	26	18,100
"	9	1	240
"	"	26	3,620
"	10	1	400
"	"	33	4,060
"	11	1	60
"	"	26	2,720
"	17	1	80
"	"	39	400
"	18	1	660
"	"	52	700
"	21	1	600
"	"	20	2,380
"	24	1	20
"	"	56	1,260
"	28	1	5,700
"	"	20	17,400
"	29	1	40
"	"	26	80
"	30	1	40
"	"	26	20
"	32	1	20
"	"	10	160
"	35	1	200
"	"	20	1,180
"	37	1	13,400
"	"	16	14,600
"	38	1	1,500
"	"	10	2,940
"	45	1	160
"	"	20	1,180
31	1	1	3,200
"	"	13	4,700
"	3	1	3,800
"	"	20	2,600
"	4	1	2,900
"	"	20	2,900

Table 2.--Total coliform count, Oswego Harbor (continued)

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
31	5	1	1,700
"	"	13	600
"	7	1	100
"	"	26	3,500
"	9	1	100
"	"	30	3,800
"	10	1	200
"	"	30	2,300
"	18	1	60
"	"	56	340
"	20	1	1,120
"	"	26	100
"	21	1	700
"	"	23	2,000
"	28	1	2,900
"	"	20	2,700
"	32	1	40
"	"	13	40
"	35	1	2,900
"	"	23	200
"	37	1	2,800
"	"	20	3,700
"	38	1	5,500
"	"	13	1,500
"	39	1	0
"	"	92	760
"	43	1	0
"	"	49	60
"	45	1	20
"	"	23	100
"	46	1	40
"	"	39	60
"	48	1	20
"	"	62	360
33	3	1	2,200
"	"	20	3,200
"	4	1	3,900
"	"	23	4,100

Table 2.--Total coliform count, Oswego Harbor (continued)

Cruise	Station No.	Depth (ft)	Total coliform (per 100 ml)
33	5	1	1,800
"	"	13	5,500
"	7	1	1,200
"	"	26	2,900
"	10	1	300
"	"	33	1,700
"	12	1	660
"	"	26	580
"	16	1	140
"	"	52	0
"	20	1	420
"	"	26	220
"	21	1	560
"	"	23	1,260
"	24	1	40
"	"	59	0
"	32	1	0
"	"	13	40
"	37	1	4,200
"	"	20	4,200
"	40	1	0
"	"	92	0
"	45	1	20
"	"	10	10
"	46	1	140
"	"	36	360
"	48	1	20
"	"	66	0
"	50	1	0
"	"	98	0

46. *Remote Sensing Program for the Determination of* Cladophora *Distribution*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - ERIM[6]

No report.

47. *Remote Sensing Study of Suspended Inputs Into Lake Ontario*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - ERIM[6]

Water-quality information and detail are available from ERTS data in the visible wavelengths. Scattering of green light (ERTS band 4) by suspended solids within the lake is indicated by light patterns. Current patterns and input sources of pollution are identifiable in the ERTS images. For example, the relatively great load of suspended solids contributed by the outfalls of the Welland Canal and the barrier effect of the Niagara plume are clearly indicated in an ERTS image of the western lake basin for August 21, 1972. This image is contained in the January-February bimonthly report to NASA Goddard Space Flight Center under contract NA55-21783. Requests for copies should be addressed to the Principal Investigator.

48. *Island-Land Precipitation Data Analysis*

Principal Investigator: F.H. Quinn - LSC/NOAA

Precipitation data have been collected continuously at the six Lake Ontario stations. Data tapes through February 1974 have been reduced, and tabulated precipitation data for 1971, 1972, and 1973 are available. Data collection will continue.

49. *Lake Circulation, Including Internal Waves and Storm Surges*

Principal Investigator: D.B. Rao - University of Wisconsin, Milwaukee

No report.

50. *Atmospheric Water Balance*

Principal Investigator: E.M. Rasmusson - CEDDA/NOAA

Processing and checking of the basic rawinsonde data continued during the quarter. Errors in temperature and humidity in the "first pass" processing were identified for correction in final processing. Preliminary analyses of temperature and humidity time-height cross sections for 6 days of Confederation Park indicate that these data are of high quality. A satisfactory technique was developed for identifying and correcting wind errors in the rawinsonde data caused by noise in the Loran-C time-delay data. Elimination of these errors makes it possible to proceed with scientific analyses.

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[6] Affiliation has been changed to the Environmental Research Institute of Michigan (ERIM).

Thorough analyses of the rawinsonde data will be undertaken during the next quarter. The 6-day period from October 30 to November 4, 1972, will be studied first, and a report of preliminary results is planned as part of a paper on this topic to be presented at the IAGLR 17th Annual Conference in August.

51. *Evaporation Synthesis*

Principal Investigator: F.H. Quinn - LSC/NOAA

First-cut evaporation data are being compared and analyzed.

52. *Groundwater Flux and Storage*

Principal Investigator: E.C. Rhodehamel - U.S. Geological Survey

The task is completed, and a report has been submitted to the U.S. Co-chairman of the Terrestrial Water Budget Panel.

53. *Spring Algal Bloom*

Principal Investigator: A. Robertson - IFYGL Project Office/NOAA

Analysis awaits availability of data.

54. *Ice Studies for Storage Term - Energy Balance*

Principal Investigator: F.H. Quinn - LSC/NOAA

A data report has been completed and is undergoing review.

55. *Lagrangian Current Observations*

Principal Investigator: J.H. Saylor - LSC/NOAA

No report.

56. *Circulation of Lake Ontario*

Principal Investigator: J.H. Saylor - LSC/NOAA

No report.

57. *Phytoplankton Nutrient Bioassays in the Great Lakes*

Principal Investigator: C. Schelske - University of Michigan

Task not activated.

58. *Runoff Term of Terrestrial Water Budget*

Principal Investigator: G.K. Schultz - U.S. Geological Survey

Work on this task is complete.

59. *Coastal Chain Program*

Principal Investigator: J.T. Scott - State University of New York at Albany

Cross sections of daily baroclinic geostrophic currents for the United States and Canadian coastal chains are being drafted. Temperature and longshore velocity cross sections are in final form for publication and are being checked for errors. Daily transport components at each of the five coastal chains are being analyzed, and transport is also being computed on an "event" basis for each chain. During the next quarter we intend to have baroclinic geostrophic daily cross sections for each buoy line in final form for publication. Examination of measured and geostrophic transports on an average basis will also continue.

A paper entitled "Observations of Baroclinic Coastal Currents in Lake Ontario During IFYGL," coauthored by G.T. Csanady, was presented by the Principal Investigator at the IFYGL Symposium, AGU meeting, in April. Based on work on that paper, we have decided that it would be useful to subdivide our line transports further into transport inside and outside the "jet" core, as well as transport above and below the thermocline. This analysis will be done for both measured and geostrophic transport, and we are currently modifying our computer program for this purpose.

60. *Analysis of Phytoplankton Composition and Abundance*

Principal Investigator: E.F. Stoermer - University of Michigan

No report.

61. *Clouds, Ice, and Surface Temperature*

Principal Investigator: A.E. Strong - NESS/NOAA

Lake surface temperatures obtained from the NOAA-2 satellite have been mapped for the following 1973 dates:

March 27	Lakes Michigan, Huron, Erie, and Ontario
May 22	Lake Ontario
June 13	Lakes Michigan, Huron, Erie, and Ontario
June 14	Lakes Michigan, Huron, Erie, and Ontario
August 21	Lake Michigan
August 22	Lake Michigan

The last two were added to our study because an extensive upwelling occurred along the eastern shore of Lake Michigan, accompanied by a subsurface precipitation of calcium carbonate that could be seen to cover the entire lake.

Figure 2 was taken by the NOAA-2 satellite on June 14. A Canadian airborne radiation thermometer (ART) flight was made over Lake Huron and Georgian Bay on the same day, and the satellite data were found to be in close agreement with the ART survey. Based on the calibration in Lake Huron, it was possible to extrapolate absolute temperature to Lakes Michigan, Erie, and Ontario. Upwelling is seen along the northern shore of Lake Ontario, and surface temperatures were found to be as low as 7°C. In Lake Erie the upwelling is not as apparent, but some cooler water can be seen along the Canadian shoreline. In Lake Huron a very obvious feature is the effect of the bathymetry of the lake in that the coolest waters (white in fig. 2) are over the deepest part of the lake. The effect of the midlake reef tending northwest to southeast is apparent in the surface temperature pattern, warmer waters being over and south of this area. We have found it necessary to average our 1-km resolution thermal infrared data over a 4-km grid to remove the high-frequency noise that is apparent in the original data stream. When this noise is removed, the standard deviation of the data in the homogenous area is on the order of the digitization of the data, or approximately 0.75°C. Further analyses and comparisons with ART and ship observations will be made this summer. A final report should be available in the early fall of 1974.

Figure 3 shows two strip images of Lake Michigan acquired on August 21, 1973, from the ERTS-1 satellite. The left image is from the multispectral sensor (MSS) 4 and the right from the MSS 5, the green and red visible light channels, respectively. On the left, green water appears over almost the entire surface of Lake Michigan. With increased pH levels and eutrophication over the last few years, milky water has been reported, which results from recent upwelling that brings nutrient-rich waters to the surface that set off massive phytoplankton blooms and a precipitation of calcium carbonate ($CaCO_3$), and raises the pH. On University of Michigan research vessels, Secchi disk readings were found to be drastically reduced as most of the chemical precipitation occurs beneath the surface down to depths of 10 m or more. (Note that MSS 5 is nearly black as it absorbs green light.) Deleterious consequences of this "whitening" have been clogged municipal water intakes at downwind locations along the Lake Michigan shoreline. The phenomenon has not been observed in Lake Huron or Superior, where calcium and pH levels are much lower than in Lake Michigan. Similar milky water periods have been noticed in Lakes Erie and Ontario, however. Within 1 hr of the ERTS-1 data acquisition, the NOAA-2 crossed the Great Lakes area and provided imagery of the upwelling along the entire eastern shore of Lake Michigan. The upwelling began during the evening of August 20, as the winds over the lake shifted

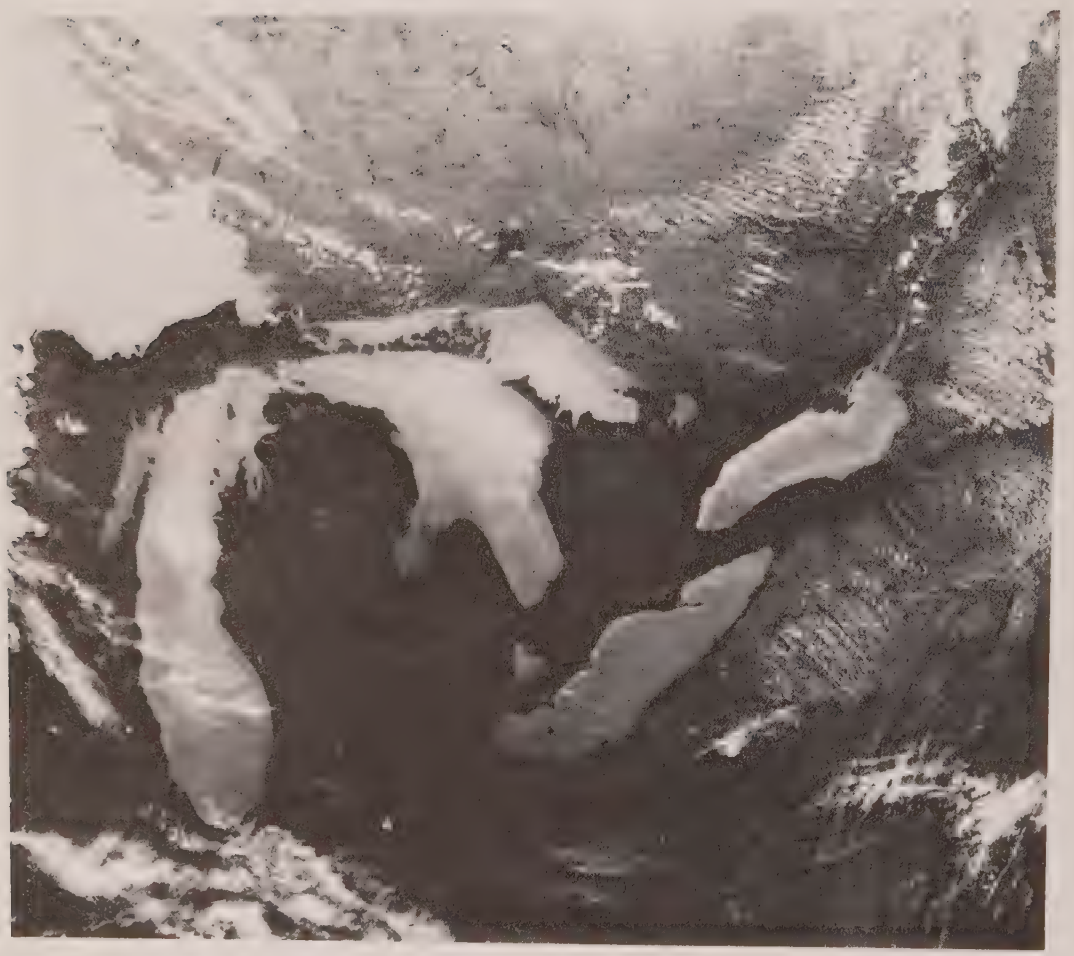


Figure 2.--NOAA-2 Satellite photograph, June 14, 1973.

Figure 3.--ERTS-1 image of Lake Michigan, August 21, 1973.

from northwesterly to northeasterly at speeds of 20 to 30 kn. A marked contrast is evident in the NOAA-2 thermal infrared image, which shows water temperatures approaching 5°C along the shoreline while readings of the remainder of the Lake Michigan surface waters are in the low 20's.

62. *Analysis and Model of the Impact of Discharges From the Niagara and Genesee Rivers on Nearshore Biology and Chemistry*

Principal Investigator: R.A. Sweeney - State University of New York at Buffalo

No report.

63. *NCAR/DRI - Buffalo Program*

Principal Investigator: J.W. Telford - Desert Research Institute, University of Nevada

Data analysis continued according to plan. The vertical wind velocity from aircraft-recorded data was calculated, and satisfactory values were obtained after appropriate corrections had been applied. The real-time integration loop of the baro-inertial altimeter was reproduced on the computer, and the calculated values of aircraft vertical velocity and altitude agree closely with the real-time recordings: within 0.05 ft/s for aircraft vertical velocity and within 10 ft for altitude. Preliminary calculations of the heat flux have begun, and results appear satisfactory.

Plans for the next quarter include possible refinements to the vertical wind and heat flux calculations. Moisture measurements have not yet been extracted from the data. This task will be undertaken after the heat flux calculations have been completed.

64. *Mathematical Modeling of Eutrophication of Large Lakes*

Principal Investigator: R.V. Thomann - Manhattan College

Work during the quarter consisted of preliminary debugging of the LAKE 3 model, continuation of preliminary runs for the LAKE 2 model, and additional sensitivity runs on the LAKE 1 model.

The LAKE 3 model is structured as a 67-segment spatial compartment model that includes five vertical layers, with the bulk of the spatial compartments defining the layers representing the epilimnion. LAKE 3 is currently being debugged to verify the transport regime, based on temperature as the verification variable and the average monthly heat flux as the input forcing function. Concurrently, the structuring of the input data for the 10-system eutrophication model is being completed. Five systems represent the biological submodel; the additional five systems, the chemical model submodel. Statistical retrievals of IFYGL data corresponding to the LAKE 3 segmentation scheme have been completed, and review of these data has begun.

The LAKE 2 model, which is a 7-layer vertical model, consists of 14 systems that define its chemical and biological submodels. A series of sensitivity runs, with temperature as a tracer, have been made to analyze the dispersion regime.

Plans for the next quarter include additional data analysis, study of various display techniques, and continued work on the LAKE models.

65. Cladophora *Nutrient Bioassay*

Principal Investigator: G.F. Lee - University of Texas - Dallas

Inactive.

66. *Sediment Oxygen Demand*

Principal Investigator: N.A. Thomas - EPA

All calculations have been completed for the rates from the sediment oxygen demand chamber. A comparative calculation will be made as soon as the dissolved oxygen data become available.

67. *Main Lake Macrobenthos*

Principal Investigator: N.A. Thomas - EPA

Identifications of benthic organisms have been completed. An analysis is now being conducted on the factors influencing the distribution of organisms throughout Lake Ontario. An analysis of the sediment composition both for size and chemical is being made.

68. *Exploration of Halogenated Hazardous Chemicals in Lake Ontario*

Principal Investigators: G.F. Lee --University of Texas - Dallas
C.L. Haile[7]- University of Wisconsin

The report for this task was inadvertently omitted in Bulletin No. 10. What follows covers activities during the past two quarters.

Pesticide fractions of Lake Ontario fish extracts have been examined for DDT group pesticides (DDT, DDE, DDD, and related isomers) and dieldrin by gas chromatographic techniques. Mean concentrations were 0.54 ppm total DDT (sum of DDT group pesticides) and 0.04 ppm dieldrin on a whole-fish basis, or 13.8 ppm total DDT and 1.0 ppm expressed with respect to extractable fish oil. In addition, gas chromatographic/mass spectrometric examination of other peaks

[7]C.L. Haile has been added as Coprincipal Investigator on this task.

in the fish pesticide fractions has begun, and the pesticide fractions of Lake Ontario sediment extracts are being screened by gas chromatography.

Pesticide and PCB fractions of Lake Ontario water and pesticide fractions of Lake Ontario sediment and some benthos and *Cladophora* have been examined quantitatively for DDT group pesticides and dieldrin by routine gas chromatographic techniques with 10-ft columns of 1 percent QF-1 on 100/120 mesh Gas-Chrom Q (or Chromasorb W). Typical column, detector, and injector temperatures and carrier gas temperatures were 180, 200, 215°C, and 35 psi, respectively. Tritium and ^{63}Ni electron capture detectors were used. Peak areas were measured with the aid of disc integrators. Water total DDT concentrations ranged up to 20 to 30 ppt, and dieldrin concentrations were as high as 5 ppt.

Both the PCB and the pesticide fractions are being examined for DDT group and dieldrin pesticides because of the incomplete separation sometimes obtained with the column chromatography fractionation procedure. The fish PBC fractions were examined for possible DDD, DDE, and DDT content. The fractions were concentrated to 0.20 ml before analysis by gas chromatography/mass spectrometry with limited scan techniques. Examination of a number of fractions for DDD and DDT by monitoring m/e 235-237 showed no fractions with more than 2 ppb of DDD and DDT (whole fish). Monitoring m/e 246-248 for DDE, however, showed significant DDE content. Whole-fish DDE concentrations of these fractions ranged as high as 0.3 ppm.

Next quarter will be devoted to the completion of the routine gas chromatographic analyses of all samples for the DDT group pesticides, dieldrin, and PCB. In addition, the bulk of the exploratory analysis of Lake Ontario fish extracts will be completed. To supplement the gas chromatographic/mass spectrometric analyses of fish extracts conducted at the Water Chemistry Laboratory, whole-fish samples will be sent to the National Water Quality Laboratory (NWQL) at Duluth, Minn., where they will be analyzed in a cooperative effort with the NWQL. The samples will be extracted, cleaned up, and analyzed on a gas chromatographic/mass spectrometric system with associated computerized data acquisition and examination.

69. *Basin Precipitation - Land and Lake*

Principal Investigator: J.W. Wilson - CEM

The report for this task was inadvertently omitted in Bulletin No. 10. What follows covers activities during the past two quarters.

Derivation of hourly rainfall estimates from 16-mm photographs of the PPI scope during periods when radar data were not collected on magnetic tape has been completed. A total of 2,500 photographs have been manually traced

and sent to the National Severe Storms Laboratory (NSSL), Norman, Okla., for planimetry. Areal measurements for each echo contour have been completed at NSSL. Of the 752 hr of missing Buffalo radar data on magnetic tape when precipitation occurred over the lake, 245 hr have been recovered from film. An additional 134 hr recovered from film from the Oswego radar account for almost all missing Oswego tape data for precipitation periods over the lake.

Maps containing gage-measured precipitation totals for the Lake Ontario watershed for each day of the Field Year have been plotted. Radar and gage precipitation totals have been examined in detail to identify errors in either data source. Particular care was taken in identifying time periods of anomalous propagation of the radar beam. Since most of these occurred when there was no precipitation, they are not a serious problem.

Preliminary daily precipitation totals have been derived for Lake Ontario for May 24 through November 1, 1972, primarily from radar data. The only use of rain gages was to make a general range correction based on seasonal comparisons of gage and radar measurements as a function of radar range.

As part of an effort to determine how best to combine the radar and gage data, the ratios between the gage and radar estimates for storm periods and extended time periods have been determined and plotted on maps. This has been done only for the Oswego radar data, but similar analyses for the Buffalo and Woodbridge radars are planned.

The final estimates for both the lake and the watershed will be obtained from a combination of radar and gage data based on a technique developed by Edward Brandes at NSSL. During a visit to NSSL in March 1974, it was agreed that the technique is ideal, but that considerable effort will be required to modify the program to accept the varied IFYGL input. Reprogramming and checkout will be the major effort during the next quarter.

70. *Evaluation of ERTS Data for Certain Hydrological Uses*

Principal Investigators: D.R. Wiesnet and D.F. McGinnis - NESS/NOAA

A snow-extent map prepared from NOAA-2 very high resolution radiometer (VHRR) data (visible band, 0.6 to 0.7 μm) for February 13, 1973, is being evaluated by comparison with ground-truth data. The snowfree area in southern Ontario corresponds rather well with the satellite data at first glance, but the boundaries are somewhat different. The analysis will continue. Airborne gamma-ray data for the same date also indicate a snowfree area.

Some progress has been made in enhancing, by computer, the VHRR visible band imagery of snow in forested regions. However, more trials are needed to determine under what circumstances this technique will work.

Analysis of aircraft thermal IR data for a specific test site is now underway; it is hoped that a soil moisture-thermal IR relationship will make estimates of soil moisture possible. The color analyzer for densitometry work has now been received, which should facilitate the soil moisture study.

71. *Distribution, Abundance, and Composition of Invertebrate Fish Forage Mechanisms in Lake Ontario*

Principal Investigator: J.H. Kutkuhn - Great Lakes Fisheries Laboratory

See Task 6.

72. *Coastal Circulation in the Great Lakes*

Principal Investigator: G.T. Csanady - Woods Hole Oceanographic Institution

The analysis of two storms during the spring alert period (WHOI Contribution No. 3035) will appear in the July 1974 issue of Journal of Physical Oceanography. A discussion of wind stress under light wind conditions (WHOI Contribution No. 3119) will be published by Journal of Geophysical Research, and another theoretical study of relevance to wind stress during the spring regime (WHOI Contribution No. 3011) is also in press, to be published in Boundary Layer Meteorology. A paper prepared jointly with J.T. Scott and entitled "Baroclinic Coastal Jets in Lake Ontario During IFYGL" (WHOI Contribution No. 3334) has been reviewed internally and submitted for publication. A review entitled "Hydrodynamics of Large Lakes" (WHOI Contribution No. 3340) has been prepared for the January 1975 issue of Annual Reviews of Fluid Mechanics. This paper summarizes the results of linear-theory interpretations of various phenomena observed both during and before IFYGL. Some success has been achieved in attacking the nonlinear problem of momentum transport by onshore-offshore movements in coastal jets. A paper on this topic has been prepared, based on which a talk was given in March at Harvard University with another presentation scheduled at Princeton in early May.

73. *Lake Water Characteristics*

Principal Investigator: A.P. Pinsak - LSC/NOAA

Further coordination with Task 7 is required before work can continue.

74. *Snow Observation Network*

Principal Investigator: Robert B. Sykes, Jr. - State University of New York at Oswego

The supplemental Oswego area weather radar snowfall study during this winter met with some success because snowfalls were heavier than last year,

when the IFYGL weather radar was installed at Fulton, N.Y. Two of the five school districts used during IFYGL participated in the supplemental study: the Central Square and Camden districts in New York State. Snow depths, water equivalents, and snow crystal types were observed by students at some 35 fixed locations. Supplemental observations were made by mobile, telephone-equipped reconnaissance units that obtained snow crystal types and measured snow depths along several transects. Procedures included snow-crystal photography and replication, and general photography. Information on clouds and standard weather parameters was also obtained. Notable was a snowburst on January 13, 1974, when 40 to 50 in of snow fell over one area over a period of about 16 hr.

75. *Lake Circulation Model*

Principal Investigator: J.R. Bennett - IFYGL Project Office/NOAA

A short note on the cyclonic circulation of large lakes was submitted to Limnology and Oceanography.

Several complete three-dimensional simulations of Lake Ontario for July 1972 have been run in an attempt to estimate the optimum surface drag coefficient and internal turbulence parameters. The coastal chain data and both the Canadian and United States buoy data are being used for verification.

76. *Lake Ontario Invertebrate Fauna List*

Principal Investigator: A. Robertson - IFYGL Project Office/NOAA

A provisional list has been developed. Work is proceeding on estimating the abundance and distribution of the various forms.

77. *Distribution and Variability of Physical Lake Properties*

Principal Investigators: E. Aubert, J. Harrison, and R. Pickett - IFYGL Project Office/NOAA

A report comparing currents from the United States and Canadian buoys at station 13 during July 1972 was completed and sent to CCIW for comments. Mean statistics for the same month were calculated and mapped for all meteorological and limnological variables. Sequential 2-day mean lake temperatures were calculated, objectively analyzed, and contoured. Temperature and current spectra were calculated for all stations at all levels.

Our edited buoy and tower meteorological and limnological data base for July 1972 is being put on tape and microfilm. Copies can be supplied to principal investigators upon request. Procedures used in editing these data are described later in this Bulletin.

78. *Carbon Cycle Model*

Principal Investigators: A. Robertson and B. Eadie - IFYGL Project Office/NOAA

A preliminary carbon budget for IFYGL has been developed. The major source was found to be inorganic carbon from the major tributary streams, especially the Niagara. The major sinks are net CO_2 gaseous exchange with the atmosphere, organic sedimentation, and inorganic outflow at the St. Lawrence River. Carbon from groundwater sources, minor rivers, municipal and industrial sources, and inorganic deposition account, in total, for less than 10 percent of the carbon dynamics.

Seasonal variations in the CO_2 gas exchange system make the lake a sink of CO_2 in the warm summer months and a source during the remainder of the year. Northshore upwelling in the fall brings water supersaturated with CO_2 to the surface, producing large gradients in the erosion rate across the lake.

Panel Reports

Biology and Chemistry - N.A. Thomas, **U.S.** Panel Cochairman

An EPA report on the 10 tasks supported by EPA funds has been printed and circulated. A limited number of copies are available from the Grosse Ile Laboratory, EPA, Grosse Ile, Mich. 48138. Many of those working on IFYGL under EPA contract have asked for time extension because of the delay in receipt of data. All these requests have been honored, and project report dates have been moved to July or August.

Boundary Layer - J.Z. Holland, U.S. Panel Cochairman

In January, the panel cochairmen, J.Z. Holland, United States, and F.C. Elder, Canada, requested a list of publications, conference papers, and project status reports from each panel member. In February, the cochairmen met in Washington, D.C., to discuss general progress and plans, and to review the replies received from the members. These replies indicated that as of January 1974 eight conference papers, of which two had been published in proceedings, had been presented based on IFYGL data analysis, and that two journal articles were in press. These and other preliminary analyses were used for a summary report presented at the IFYGL Symposium, AGU meeting, in April 1974. The panel plans to hold a meeting at McMaster University in Hamilton, Ontario, in August 1974.

Lake Meteorology - E.M. Rasmusson, United States Panel Cochairman
J.A.W. McCulloch, Canadian Panel Cochairman

A paper describing the lake meteorology program, and summarizing the results to date, was coauthored by the panel cochairmen and presented at the IFYGL Symposium, AGU meeting, in April 1974. A publication plan for input from the lake meteorology program to the IFYGL Scientific Report series was presented at a meeting of the Joint Management Team on April 10, 1974.

F. Quinn has replaced E. Rasmusson as U.S. project leader for the evaporation synthesis project.

Terrestrial Water Balance - B.G. DeCooke, U.S. Panel Cochairman

A revised outline of the final report on the terrestrial water balance was distributed to both the United States and Canadian principal investigators on January 25, 1974, with comments requested by March 15. Five replies had been received as of April 8, 1974. The outline will be further revised and submitted to the Joint Management Team for review.

DATA MANAGEMENT

Data Processing

The status of data processing done at the Center for Experiment Design and Data Analysis (CEDDA) is given below. The various data sets, as they are completed, will be available from the National Climatic Center (NCC) in accordance with the IFYGL Archive Plan discussed in a later section.

Ship System

All navigation entries from the dead reckoning abstract (DRA) logs have been coded, punched, corrected, and verified. These have been forwarded to NCC.

The program design for the final edit run is in the last stages of checkout. Averaging procedures have been verified and approved by the IFYGL Project Office.

Time series microfilm plots of the 1-s averages are being generated for all cruises. Time-series plots will also be generated for the 6-min average data as they become available.

Physical Data Collection System (PDCS)

Provisional PDCS data for May, June, July, and October 1972 are available. They contain merged data from all PDCS sources, with valid calibrations applied. The data have not been edited, and gross errors may be present. All these data are available on seven-track, 800 BPI, BCD tapes. Microfilm displays of the individual 6-min observations (fig. 4) and the time series (fig. 5) are also available. Table 3 indicates the progress made in generating the Provisional Data Base. Original copies of all microfilm have been forwarded to NCC. The tapes are being copied and verified and will be sent to NCC when completed.

Editing of the PDCS data is being done according to the procedures outlined in IFYGL Bulletin No. 9. The editing routines have been written and are now being tested.

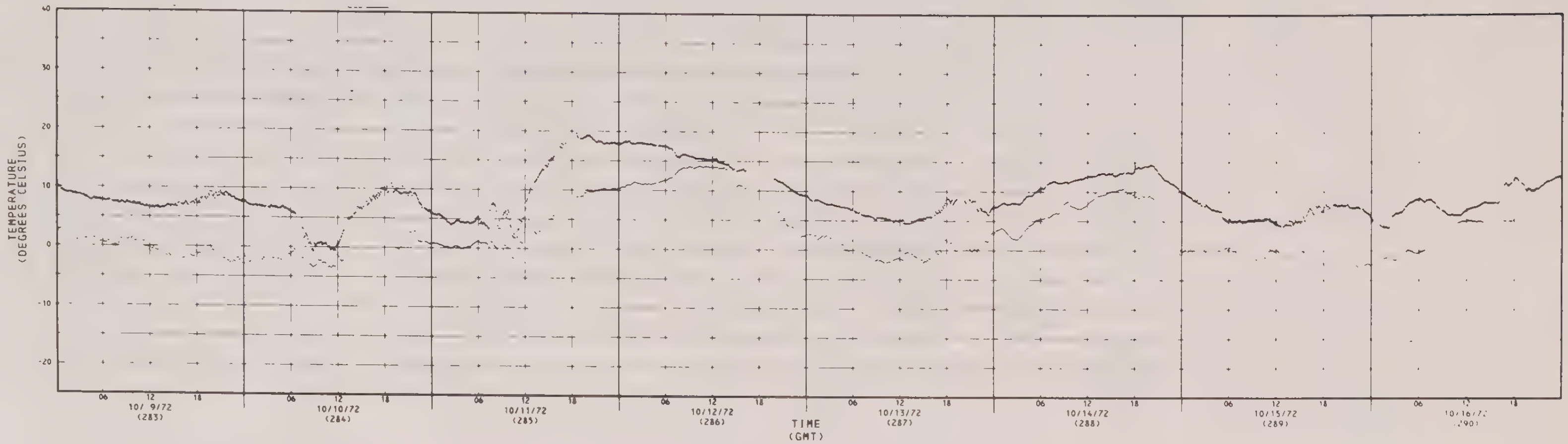
FRAME 1
PROVISIONAL DATA - DATA WILL BE TREATED FURTHER.

COMPUTER GENERATED ON APRIL 10, 1974

NOAA/IFYGL

EIGHT DAYS OF MEASUREMENTS OBTAINED AT 6 MINUTE INTERVALS - OCTOBER 9, 1972 THRU OCTOBER 16, 1972 TIME GIVEN IN GMT.
PDCS STATION NUMBER 2 (INTERNATIONAL STATION LOCATION NUMBER 22, LATITUDE 43°16'21 N, LONGITUDE 79° 0'21 W), LAND PLATFORM

PDCS SENSOR POSITION 1, AIR TEMPERATURE AT 1.5 METERS ABOVE LAND. LINE INTENSITY ————
PDCS SENSOR POSITION 6, DEW POINT TEMPERATURE AT 1.5 METERS ABOVE LAND. LINE INTENSITY ————



PDCS SENSOR POSITION 5, BAROMETRIC PRESSURE AT 1.5 METERS ABOVE LAND. LINE INTENSITY ————
PDCS SENSOR POSITION11, PRECIPITATION AT 1.5 METERS ABOVE LAND. LINE INTENSITY ————

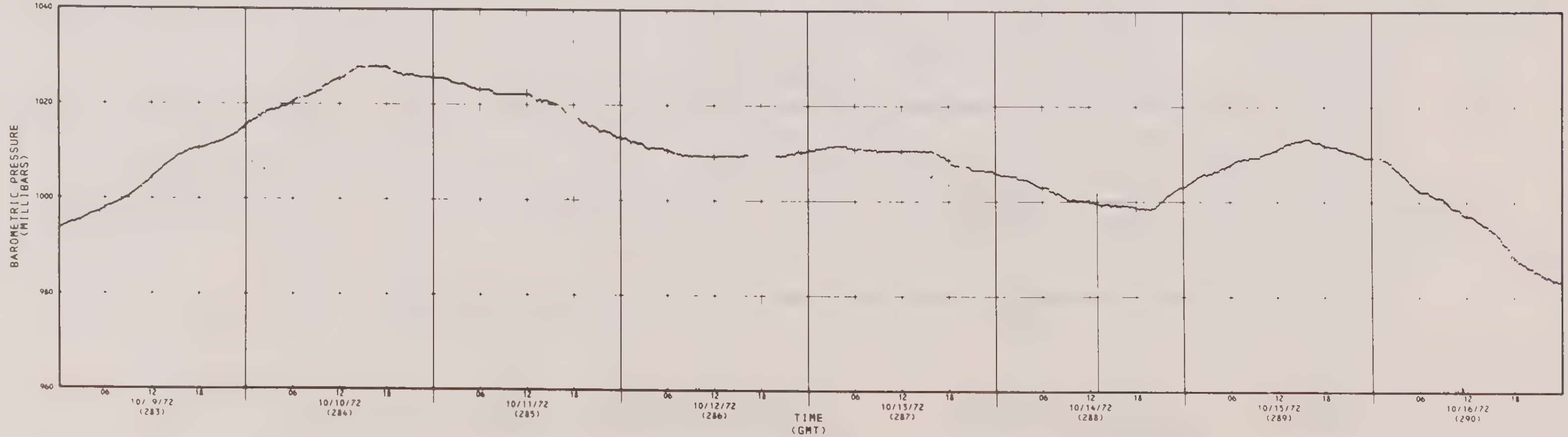


Figure 4.--Example of PDCS 6-min display.

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES - PHYSICAL DATA COLLECTION SYSTEM   GENERATION DATE 04/10/74 12.06.06.
IFYGL STATION 22   PLATFORM   LAND STATION (NIAGARA)   PARAMETER AIR TEMPERATURE   FRAME NO 3
LATITUDE 43 16 21   LONGITUDE 79 00 21   HEIGHT/DEPTH 1.5 M.   UNITS DEG C

13 OCT 1972 287	MINUTE / HOUR	00	06	12	18	24	30	36	42	48	54
	0	9.18	9.18	8.92	8.78	8.45	8.52	8.45	8.32	-99.99	-99.99
	1	8.32	8.52	8.45	8.45	8.52	8.45	8.38	8.32	8.25	8.12
	2	8.12	8.05	7.99	7.85	7.91	7.78	7.71	7.78	7.71	7.71
	3	7.65	7.78	7.78	7.71	7.65	7.58	7.52	7.58	7.45	7.38
	4	7.52	7.45	7.38	7.32	7.25	7.25	7.32	7.32	7.25	7.19
	5	7.19	7.19	7.19	7.05	7.05	7.05	6.78	6.85	6.91	-99.99
	6	-99.99	6.65	6.38	6.52	6.38	-99.99	6.25	6.38	-99.99	-99.99
	7	6.05	5.91	5.85	5.98	5.85	5.72	5.85	5.78	5.91	5.78
	8	5.72	5.78	5.65	5.65	-99.99	5.52	5.38	5.25	5.19	5.25
	9	5.58	5.52	5.52	5.52	5.45	5.45	5.45	5.52	5.38	5.38
	10	5.32	5.45	5.32	5.19	5.19	5.32	5.25	5.12	-99.99	-99.99
	11	4.98	4.72	4.85	5.05	5.05	4.98	4.98	4.92	4.98	5.05
	12	4.98	5.12	5.12	5.19	4.59	4.59	4.52	4.52	4.52	4.52
	13	4.52	4.52	-99.99	4.59	4.66	4.72	4.79	4.79	4.98	4.92
	14	5.12	5.19	5.12	5.32	5.32	5.32	5.38	5.32	5.38	5.32
	15	5.52	5.45	5.32	5.58	5.65	5.65	5.58	5.65	5.72	5.52
	16	5.65	-99.99	-99.99	-99.99	5.98	6.58	6.32	6.32	6.38	6.85
	17	6.52	6.45	6.85	6.85	7.45	7.19	7.71	8.05	8.52	8.92
	18	7.91	8.71	8.71	8.38	8.05	8.38	8.58	7.71	7.99	8.25
	19	8.45	8.52	8.71	-99.99	-99.99	-99.99	-99.99	-99.99	-99.99	-99.99
	20	-99.99	-99.99	8.38	8.18	8.05	8.78	-99.99	-99.99	8.65	8.52
	21	8.92	8.25	8.32	8.38	8.45	8.38	8.38	7.85	7.05	6.72
	22	6.78	7.99	7.19	6.85	7.12	6.72	6.05	6.58	6.72	6.52
	23	6.52	6.19	5.98	6.05	6.52	6.78	7.05	7.19	7.25	7.38
14 OCT 1972 288	HOUR										
	0	7.32	7.32	7.38	7.32	7.38	7.58	7.58	7.71	7.78	7.85
	1	7.99	7.99	8.05	8.12	7.91	7.91	7.85	7.78	7.85	7.85
	2	7.85	7.91	8.05	7.99	7.99	8.05	7.91	8.05	7.99	7.91
	3	7.91	7.99	7.85	7.91	8.05	8.18	8.18	8.52	8.71	8.85
	4	8.92	9.18	9.25	9.25	9.32	9.32	9.32	9.32	9.32	9.45
	5	9.52	9.79	9.85	9.99	9.99	10.18	10.25	10.38	10.51	10.51
	6	10.64	10.64	10.64	10.51	10.58	10.85	-99.99	-99.99	11.24	11.37
	7	11.44	11.57	11.51	11.57	11.71	11.71	11.71	11.77	11.71	11.64
	8	11.51	11.57	11.51	11.44	11.51	11.44	11.51	11.57	11.57	11.64
	9	11.64	11.71	11.64	11.71	11.51	11.51	11.64	11.71	11.77	11.77
	10	11.84	11.91	11.97	11.97	12.04	12.04	12.04	12.10	12.17	12.10
	11	12.24	12.24	12.10	12.24	12.30	12.30	12.50	12.50	12.50	12.57
	12	12.64	12.64	12.50	12.64	12.64	12.64	12.64	12.70	12.64	9.79
	13	12.70	12.83	12.97	13.03	12.90	13.03	13.03	13.10	13.16	13.16
	14	13.10	13.10	12.90	12.90	12.90	13.10	13.10	13.10	13.03	13.03
	15	13.10	13.23	12.83	12.70	12.70	12.77	12.77	12.83	12.90	13.03
	16	13.10	13.16	13.10	13.16	13.16	13.29	-99.99	-99.99	13.16	13.23
	17	13.29	13.29	13.29	13.16	13.23	13.16	13.16	13.23	13.50	13.89
	18	14.43	14.02	13.96	14.09	14.22	14.16	14.02	14.02	14.09	14.16
	19	14.22	14.22	14.36	-99.99	14.36	14.29	14.36	14.36	14.43	14.56
	20	14.56	14.56	14.49	14.43	14.36	14.02	13.89	13.83	13.63	13.23
	21	13.10	13.03	12.90	12.77	12.50	12.37	12.24	12.04	11.97	11.97
	22	11.91	11.84	11.84	11.64	11.51	11.44	11.37	11.31	11.37	11.18
	23	11.11	11.04	10.91	10.78	10.64	10.64	10.25	10.12	10.05	-99.99

** NOTE ** PROVISIONAL, UNEDITED DATA, BEST ESTIMATE OF TRANSFER EQUATIONS AT TIME OF PROCESSING ** NOTE **

** NOTE ** -99.99 DENOTES MISSING DATA ** NOTE **

Figure 5.--Example of PDCS time series.

Table 3.--PDCS Provisional Data Base

Task	Monthly Data Increment										
	July	Oct.	May	June	Aug.	Sept.	Nov.	Dec.	Jan.	Feb.	Mar.
1. Preliminary workup (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
2. Automatic processing (LSC)	x	x	x	x	x	x	x	x	x	x	x
3. Verify automatic RCC processing (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
4. Manual RCC processing (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
5. Generate cassette parameters (CEDDA)	x	x	x	x	x	x	x	NA	NA	x	x
6. Automatic cassette processing (LSC)	x	x	x	x	x	x	x	NA	NA	x	x
7. Manual cassette processing (CEDDA)	x	x	x	x	x	x	x	NA	NA	x	x
8. Merge all data (LSC)	x	x	x	x							
9. Generate graphics, perform analysis (CEDDA)	x	x	x	x							

x = completed.
NA = not applicable; cassette data not available.

Documentation of the PDCS operational phase has been completed and is being edited.

Most of the DECCA coordinates and geographic positions of the PDCS water towers and buoys were found to be in error. Table 4 gives the correct station positions, and table 5 indicates the change (Δ) in position in both seconds of arc and meters, and the resulting shift in position. The change is defined as the old position minus the new coordinates.

Table 4.--Corrected PDCS station positions

IFYGL Station No.	DECCA Red	DECCA Green	Latitude (N)	Longitude (W)
12	H16.40	A39.03	43°34'47"	78°46'43"
13	I07.88	A44.80	43°25'59"	78°44'15"
23	I14.88	B30.05	43°21'26"	78°42'49"
24	I16.23	B30.63	43°20'37"	78°42'37"
14	D14.90	B44.77	43°35'32"	78°01'02"
15	E10.04	C39.94	43°25'24"	77°56'19"
16	D15.05	D35.24	43°27'36"	77°43'54"
17	C05.87	E44.20	43°36'07"	77°23'51"
26	E06.06	D36.75	43°21'42"	77°45'17"
27	E08.10	D37.06	43°20'52"	77°45'23"
18	C13.35	H32.21	43°26'24"	76°56'46"
19	B13.33	I41.94	43°41'41"	76°44'36"
20	B23.72	I44.08	43°33'00"	76°37'57"
21	B12.53	A30.25	43°41'36"	76°26'10"

Table 5.--Changes in station position

IFYGL station No.	ΔΦ (seconds of arc)	Δλ	ΔΦ (meters)	Δλ	Resulting shift (meters)
12	-01	-02	-30	-46	55
13	04	03	120	69	138
23	01	00	30	0	30
24	00	00	0	0	0
14	00	08	0	184	184
15	115	218	3,450	5,014	6,086
16	-13	12	-390	276	478
17	-18	-05	-540	-115	552
26	-07	-16	-210	-368	424
27	-07	17	-210	391	444
18	-38	14	-1,140	322	1,185
19	-46	-11	-1,380	-253	1,403
20	-57	02	-1,710	46	1,711
21	-65	-09	-1,950	-207	1,961

1 s of Φ = 30 m.
1 s of λ at 44^{o}Φ = 23 m.

Rawinsonde Data Processing

During the manual editing of the IFYGL rawinsonde flights, reoccurrence of certain types of errors was noted. To determine more precisely the amount and type of these errors, a survey was made of a sample period of 6 days, chosen at random. The first and last 6 days of IFYGL were not considered, nor were periods of nonintensive observations. The 6 days were October 4, 8, and 12, and November 3, 15, and 26, 1972. The number of scheduled observations was 288 (8 observations from each of the 6 rawinsonde stations daily).

Each flight was analyzed to determine the types of errors that occurred and the portion of the flight that could be processed automatically, without any manual corrections.

Errors were encoded according to the following guidelines:

(a) An error was encoded only once per flight regardless of severity or time period covered.

(b) When the specific cause of an error could be established from event logs, strip charts, microfilm, and other backup material, the cause was encoded.

(c) When a specific cause could not be determined, the behavior of the signal, as seen on microfilm, was encoded.

Table 6 shows the results of the survey in terms of types of errors and the percentage of flights during which they occurred. Note that only errors that occurred in more than 5 percent of the flights are listed and that the percentages are not additive, because more than one error may have occurred during any one flight. Table 7 summarizes causes of flight termination. As shown, almost 50 percent of the flights were terminated for reasons other than hardware or software malfunction. Note that only causes in more than 5 percent of the flights are listed and that the percentage may be smaller than true occurrences, because only the first cause of termination for each flight was encoded.

Of the total flight time over which potentially processable data were obtained, 73.8 percent could be processed automatically, without manual corrections. Because the quality of the data was not evaluated in the survey, and because the same error could have occurred more than once during the same flight, this percentage understates the amount of manual corrections needed to obtain usable data.

Some type of Loran signal error occurred in 61 percent of the flights. However, these errors were generally of short duration and data could be recovered in most cases.

Table 6.--Summary of rawinsonde error occurrence

Code	Type of error	Percentage
423	Noise in both the Nantucket and Dana Loran strip-chart traces at the same time (noise in the common transmitter, Cape Fear, signal).	41.7
114	Noise of unknown origin in the contacts.	28.5
319	Distortion of the meteorological data, contacts, and references into spikelike projections across the frequencies (fig. 6).	25.7
119	Noise of unknown origin in all meteorological data, contacts, and references.	15.6
511	Instrument failure, resulting in signal loss.	7.6
433	Both Nantucket and Dana Loran strip-chart trace drift -- slow lane jump -- over a short time period (noise in the common transmitter, Cape Fear, signal, fig. 7).	7.6
374	Appearance of midreference in place of contact (fig. 8).	7.3
383	Because of a missing parameter, incorrect processing of subsequent parameters (fig. 9).	6.9
392	Contact "strung out" across the frequencies, causing confusion as to which contact actually came in (fig. 10).	6.9
512	Instrument failure, resulting in badly distorted meteorological data signal.	6.6
200	Capture by the ground station of another rawinsonde (fig. 11).	6.6
122	Interference from an unknown source.	5.9
391	Occurrence of midreference within a contact, causing the program to see two contacts instead of one (fig. 12).	5.9
121	Interference from another rawinsonde.	5.6
431	Nantucket Loran signal drift (slow lane jump) over a short time period.	5.6

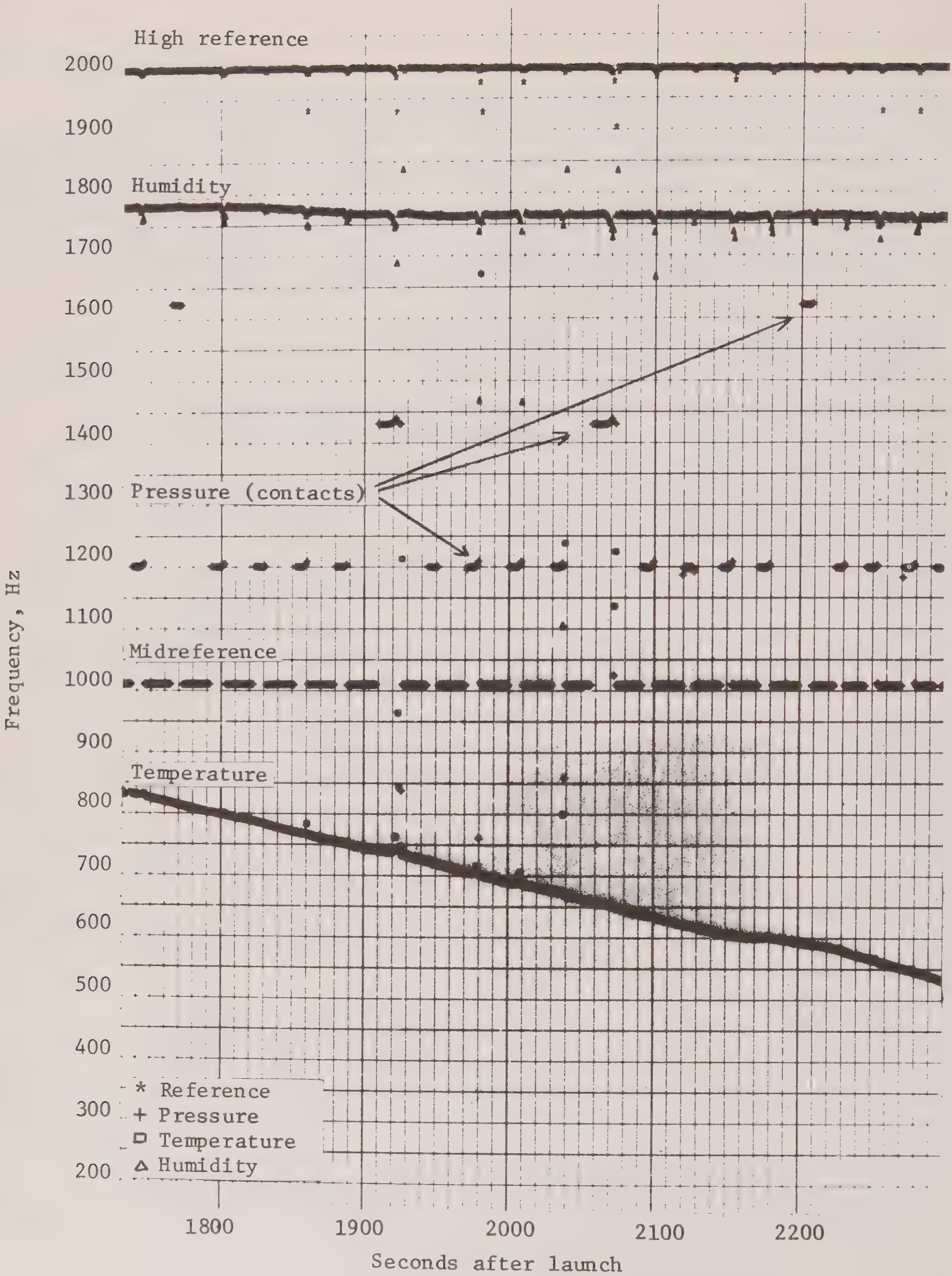


Figure 6.--Example of error code 319. Also illustrates an infrequent error: interchange of frequencies between the units contacts (nominally 1650) and the fifteenth contact (nominally 1200).

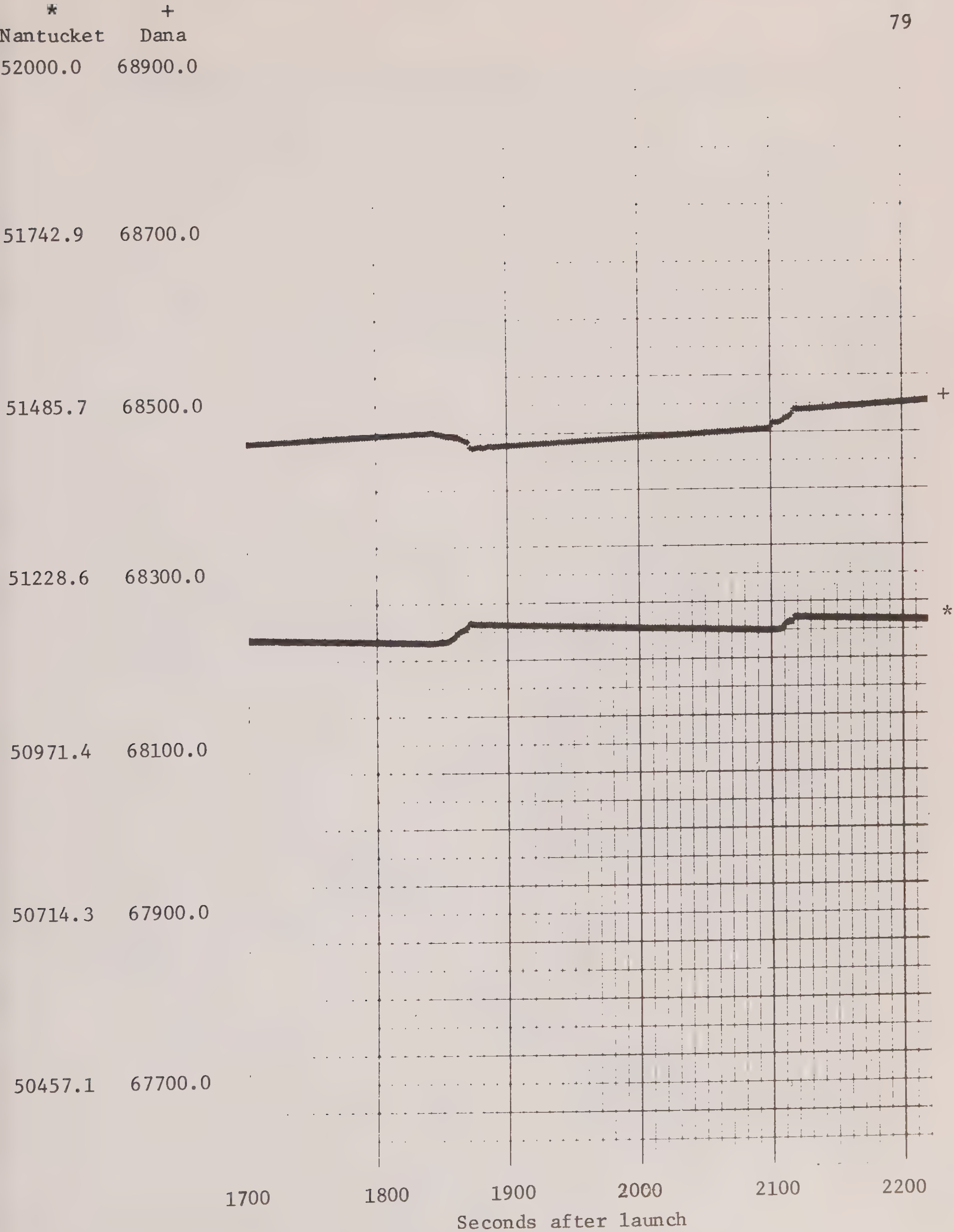


Figure 7.--Example of error code 433.

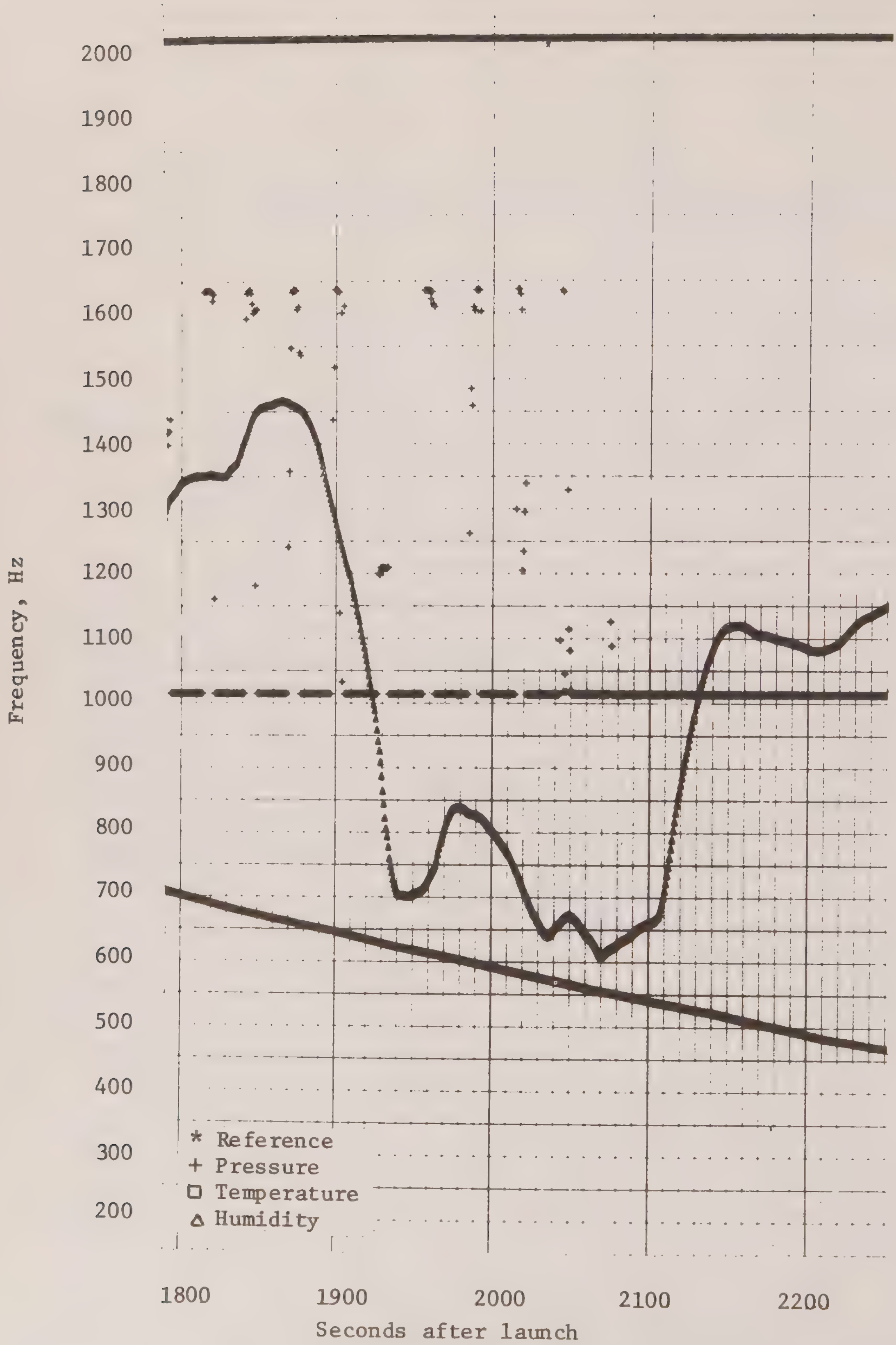


Figure 8.--Example of error code 374.

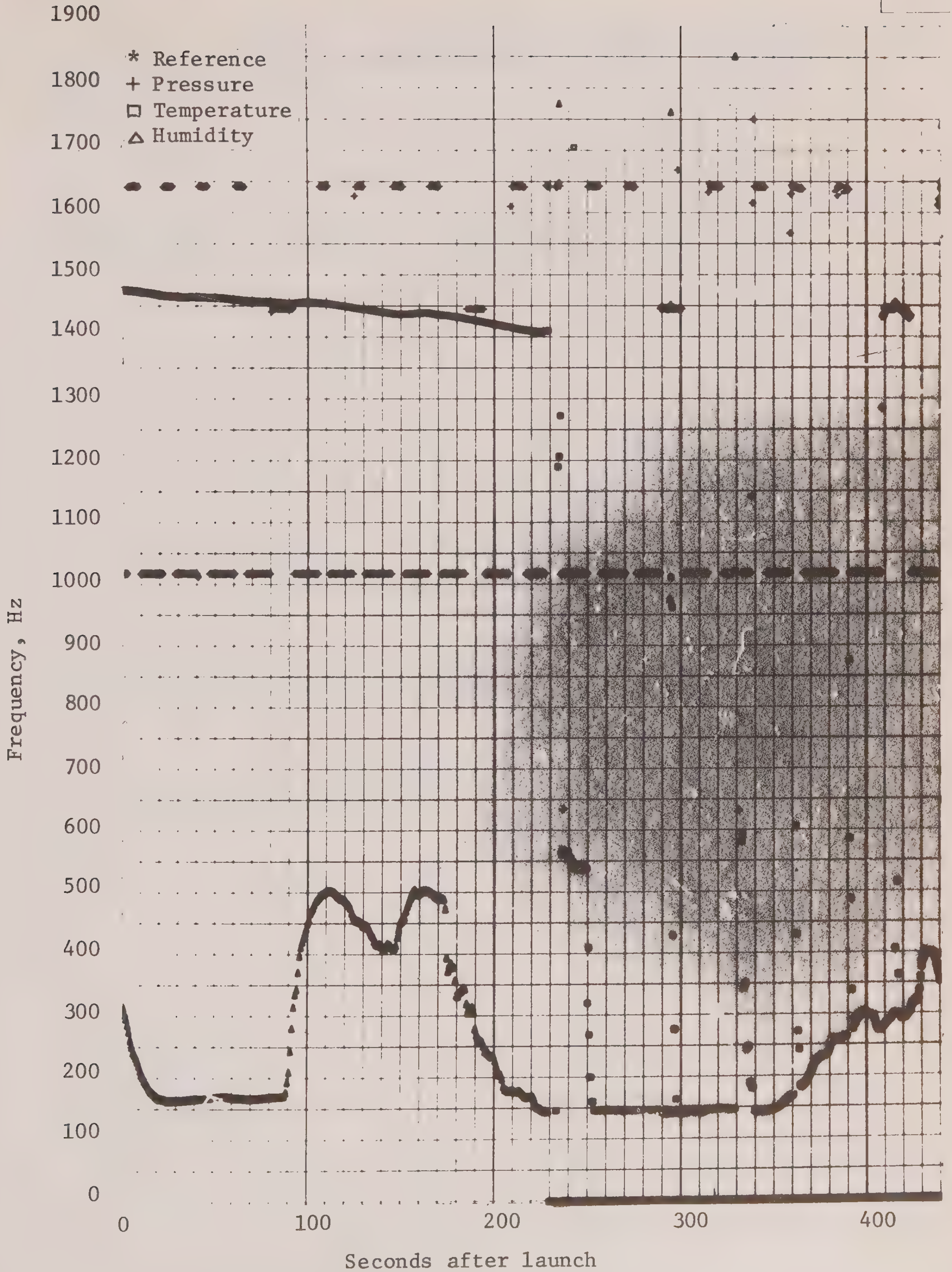


Figure 9.--Example of error code 383.

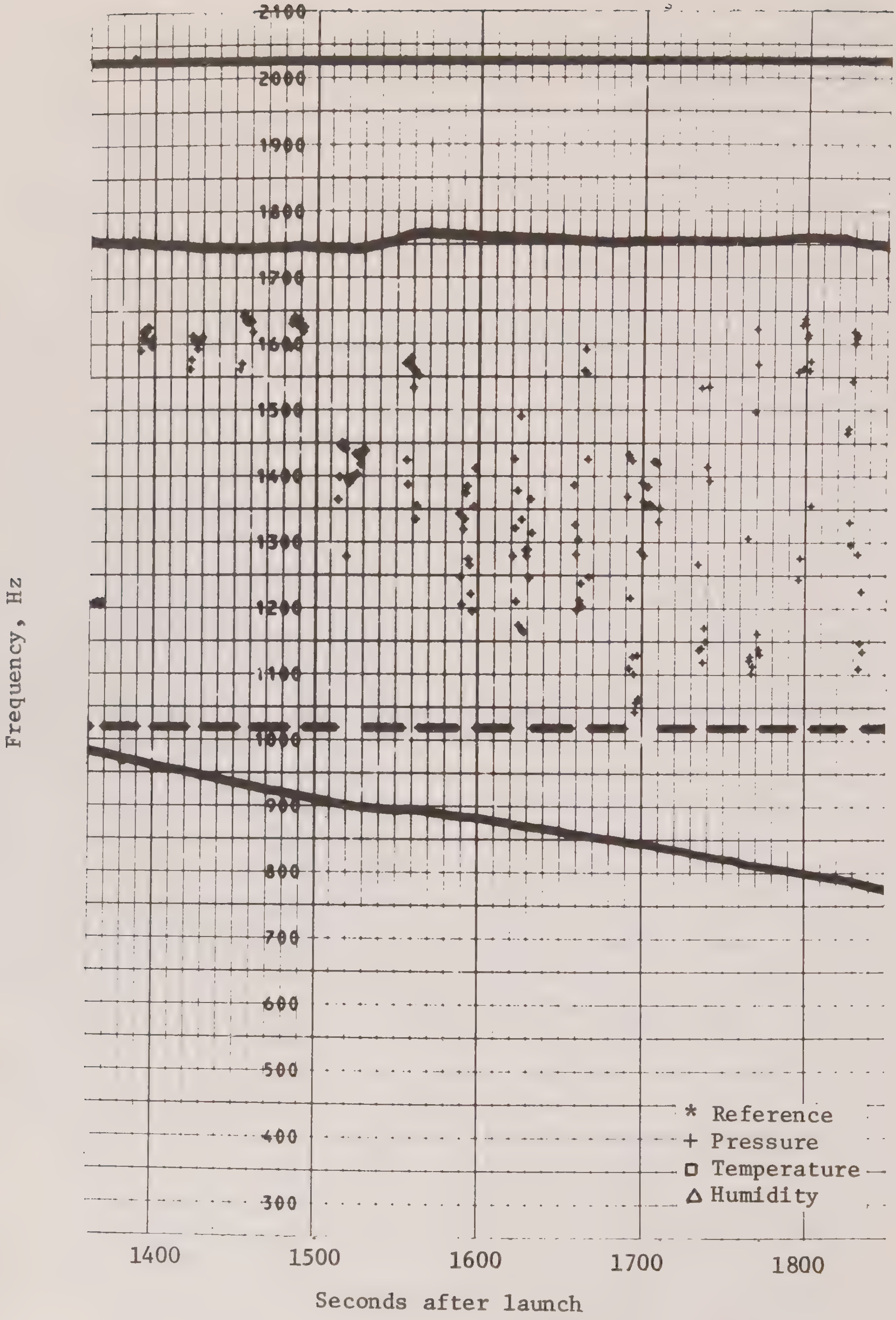


Figure 10.--Example of error code 392.

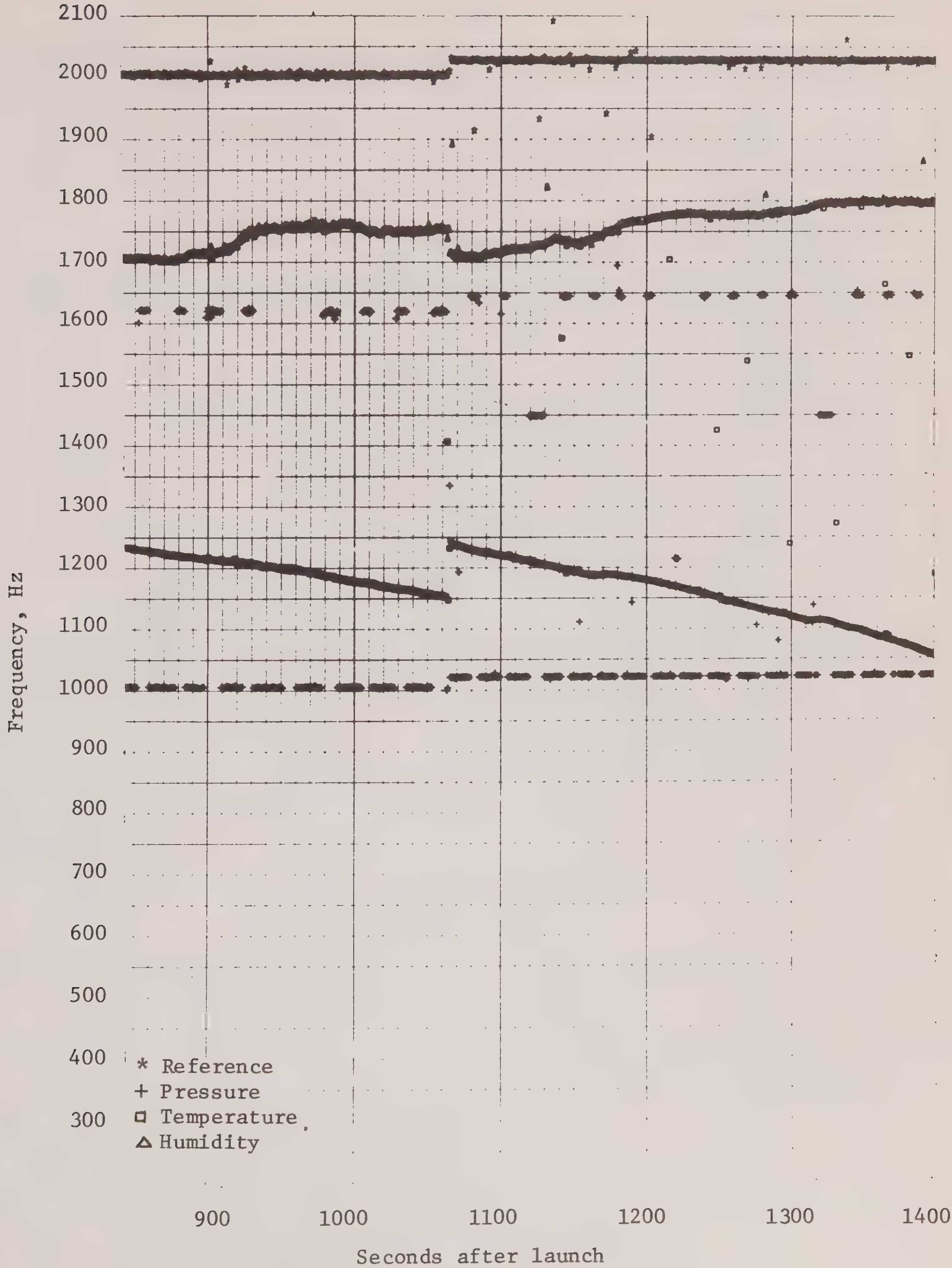


Figure 11.--Example of error code 200.

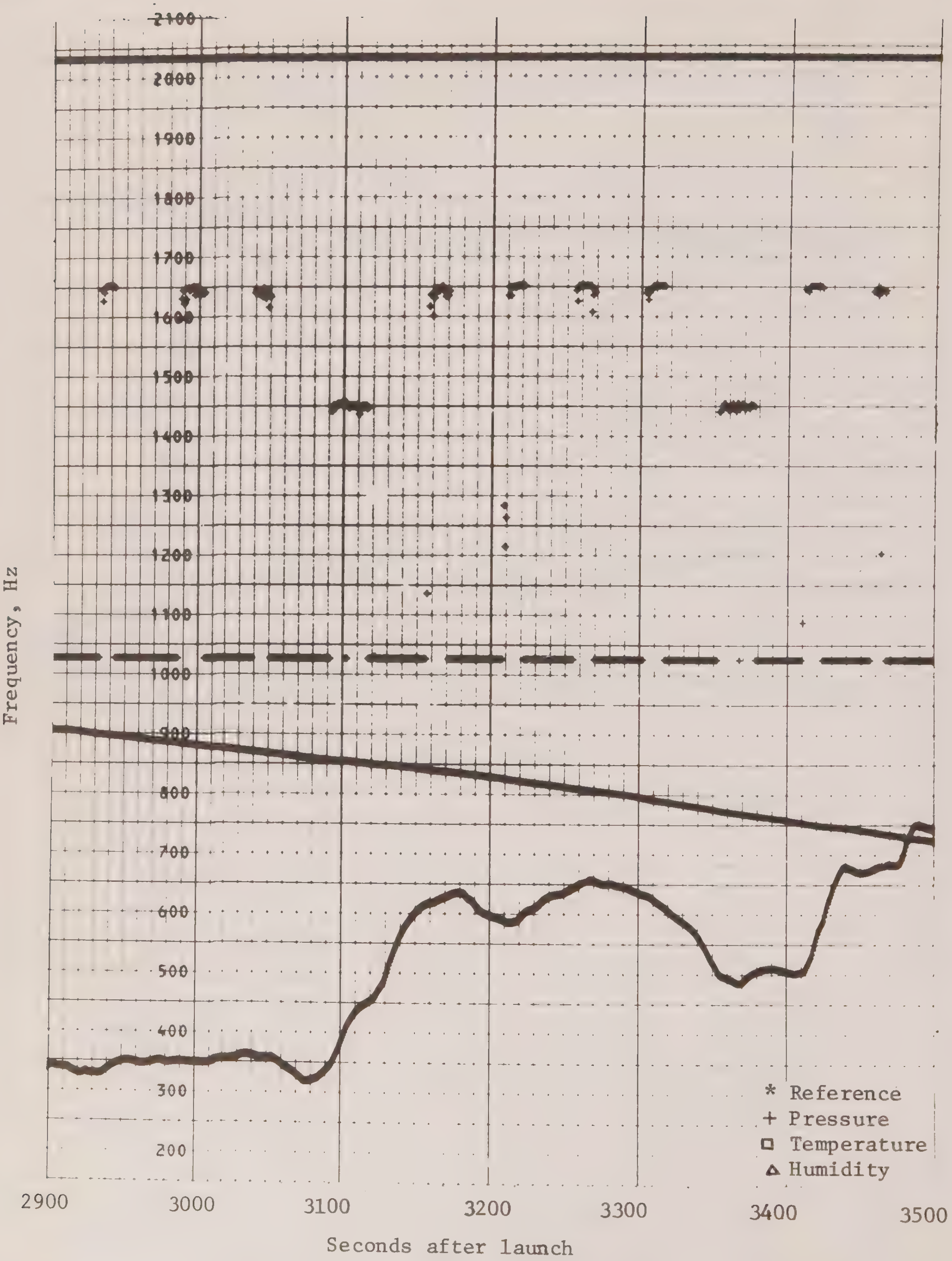


Figure 12.--Example of error code 391.

Table 7.--Causes of rawinsonde flight termination

Code	Causes	Percentage of flights terminated
550	Balloon burst.	39.6
540	Project limitations.	10.0
374	Appearance of midreference in place of contact (possibly recoverable).	6.9
383	Because of a missing meteorological parameter, subsequent parameters incorrectly processed (possibly recoverable).	6.6
511	Instrument failure, resulting in signal loss (unrecoverable).	6.3
391	Occurrence of midreference within a contact, causing the program to see two contacts instead of one (recoverable).	5.9
200	Capture by the ground station of another rawinsonde (unrecoverable).	5.2

IFYGL Archive

In January 1974, the National Climatic Center (NCC), Environmental Data Service, NOAA, was given the responsibility for the IFYGL Archive, to assume the archival functions originally intended for the proposed Great Lakes Data Center discussed in the IFYGL Technical Plan, Vol. IV. Since January, a special team of NCC and IFYGL data management personnel has established and implemented a plan for the IFYGL Archive that has been presented to the IFYGL Joint Management Team and the Panel Cochairmen. However, since the data flow into the archive has been irregular and the data sets are heterogenous, many details concerning the structure of the archive and servicing of data requests are still in the developmental stage.

Archive Data

In addition to placement in the IFYGL Archive of the data processed at CEDDA, efforts have been made to pull together and summarize knowledge of data originating from each of the individual IFYGL tasks. Through direct contact with the United States investigators, information was obtained on the status of the various data sets as summarized in table 8. A similar table for the Canadian data was constructed from the "Data Submission List" issued by the Canadian Data Management staff on August 7, 1973 (table 9). In these tables, the task numbers correspond to those used in the IFYGL Bulletin series. The numbers in the column under "Investigator" refer to line items in the archive plan and serve as further identification of individual data subsets. The key to the "Archive" column is as follows:

Y = Yes. The original or suitable copy will be placed in the archive.

PI = The Principal Investigator or his organization will retain the data. If decision is made later to release data, NCC will accept them either for temporary storage or permanent retention, as specified in each case.

? = Data are being considered for placement in the archive.

T = Temporary retention as specified for original data in the IFYGL Technical Plan.

Investigators are being provided with copies of detailed information sheets concerning their projects for review and correction. U.S. investigators who have questions regarding entry of their data into the archive may direct inquiries to:

National Climatic Center
Environmental Data Service, NOAA
Federal Building
Asheville, N.C. 28801
Attention: IFYGL, Room 52

Tel: FTS, 704-254-0754; commercial, 704-254-0961, Ext. 754

Basic Data Inventory

A "by parameter" summary, derived from the IFYGL Data Catalogue, has been prepared. Although many updates are still required, it is believed that early publication of the inventory would be useful to IFYGL investigators in locating data of interest and as a means of providing updated information for inclusion in the IFYGL Archive.

Data Requests

U.S. data request files have been revalidated and updated at NCC through direct contact with the IFYGL investigators. All requests for IFYGL data will be serviced through the IFYGL Archive at NCC. However, requests from U.S. IFYGL investigators should be directed to:

Center for Experiment Design and Data Analysis
Environmental Data Service, NOAA
Page Building 2
Washington, D.C. 20235
Attention: IFYGL Data Manager, D2x1

As stated by the Director, U.S. IFYGL Project Office, in IFYGL Bulletin No. 6: "Data requests from U.S. IFYGL participants will be filled to the extent feasible and as required for carrying out analysis as specified in the IFYGL Technical Plan. Service charges will be imposed to cover retrieval costs for other data requested that do not meet the criteria established by the Technical Plan."

Others interested in obtaining IFYGL data should address requests to:

The Director
National Climatic Center
Environmental Data Service, NOAA
Federal Building
Asheville, N.C. 28801
Tel: 704-254-0961, Ext. 754

Table 8.--Summary of data for final IFYGL Archive: United States

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	ATMOSPHERIC BOUNDARY LAYER				
3	Bean	RFF/DC-6 (Gust Probe)				
		3. Reduced turbulence data.	Mag. tape	Oct. '74	Y	Oct. '74
		4. Computed flux spectra, time series spectra.	Microfilm	Now	Y	Apr. '74
		5. Time series graphics (u,v,w,T,ρ_w).	Microfilm	Now	Y	Apr. '74
		6. Means, variances and fluxes.	Pages	Now	Y	Apr.-July '74
		7. Data reports/user's guide.	Pages		Y	
		8. Open literature papers.	Pages		Y	
5	Businger	Profile Mast and Tower				
		4. Edited meteorological data time series 50/s (Rochester).	Mag. tape	Jan. '75	?	Jan. '75
		5. Computed profile and flux data.	Mag. tape	Jan. '75	Y	Jan. '75
		6. Final report.	Pages		Y	
14	Estoque	Boundary Layer Structure				
		1. Land meteorological stations: surface meteorological data.	Strip chart	July '74	PI	
		3. Tethered balloon (BLIP): meteorological data summary.	Pages	Now	Y	Apr.-July '74
		7. PIBAL observations: wind components.	Pages	Now	Y	Apr.-July '74
		8. Cloud cover photography: time lapse.	16-mm film	July '74	PI	
		9. Cloud cover photography: still.	Neg. film	July '74	PI	
38	Panofsky	Niagara Bar Tower				
		2. Raw wind speed fluctuations.	Analog mag. tape	Aug. '74	?	
		3. Reduced wind speed fluctuations.	Mag. tape	Aug. '74	Y	Aug. '74
		4. System description report.	Pages	Now	Y	Apr.-July '74
		5. Final report.	Pages	Sept. '74	Y	Sept.-Oct. '74
		6. Open literature papers.	Pages		Y	
63	Telford	NCAR/DRI Aircraft				
		2. Reduced data: gust probe, meteorological sensors.	Mag. tape	Now	PI	
		3. Reduced data: time, location, u,v, water temperature, dewpoint, pressure.	Mag. tape		?	
		4. Reduced data: Calcomp plots of aircraft track, 6-s wind vectors.	Graphs		PI	
		5. Final data report: computed fluxes of momentum, heat, vapor (1/min).	Pages	June '75	Y	June '75
	PANEL	BIOLOGY - CHEMISTRY				
1	Armstrong	Sediment Analysis				
		2. Final report.	Pages		Y	
4	Burris	Water Sample Analysis				
		2. Final report.	Pages		Y	
7	Casey	1. Material Balance		(STORET)		
		3. Final report.	Pages	July '74	Y	July-Aug. '74

Table 8.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	BIOLOGY - CHEMISTRY (Cont'd)				
19	Hetling	1. Transport of Nutrients		(STORET)		
		3. Final report.	Pages	Nov. '74	Y	Nov. '74
21	Davies	1. Hazardous Material Flow		(STORET)	Y	
		3. Water temperature chart.	Page		Y	
		4. Final report.	Pages		Y	
22	Kim	Remote Measurement of Chlorophyll				
		2. Surface chlorophyll A maps.	Sheets		Y	
		4. Final report.	Pages		Y	
26	Lee	Algal Nutrient Availability				
		2. Preliminary report.	Pages		Y	
		3. Final report.	Pages		Y	
29	McNaught	1. Zooplankton Production	Mag. tape	(STORET)	Y	
		4. Acoustical profiles.	Sheets		PI	
		5. Zooplankton concentration samples.				
		6. Final report.	Pages		Y	
6	Kutkuhn	Status of Fish Population				
		1. Fish samples: size, numbers.	Pages	Now	Y	Apr.-July '74
		2. Fish samples: size, numbers.	Punched cards	Now	PI	
		3. Water temperature (BT)	Slides	Now	Y	Apr. '74
		4. Digitized BT, 5 fathoms.	Punched cards	Now	Y	Apr. '74
		5. Researcher fathometer (echo sounding)	Rolls	Now	PI	
		6. Final report.	Pages	Dec. '75	Y	Dec. '75
12	Carter	2. Rochester Embayment Study	Mag. tape	Now	Y	Apr. '74
		4. Current speed and direction.	Mag. tape	Aug. '74	Y	Aug. '74
		6. Digitized (sampling rate ?).	Mag. tape		Y	
		9. Beach stations: chemical and wind data.	Mag. tape	Aug. '74	Y	Aug. '74
		10. Gravity magnetic survey.	Mag. tape	(CEDDA)	PI	
		11. Researcher fathometer (echo sounding)	Strip chart		PI	
44	Bell	Shenehon (Ship) Data				
		2. Final meteorological 6-min.	Mag. tape	Apr. '74	Y	Apr. '74
		3. Radiation ? .	Strip chart	Now	Y	Apr. '74
		5. Chemical/digitized BT (1 m).	Mag. tape	Apr. '74	Y	Apr. '74
		6. Final report.	Pages	June '74	Y	June-July '74
71	Kutkuhn	Distribution and Abundance of Invertebrates				
		1. Invertebrate specimen inventory.	Punched cards	Now	Y	Apr. '74
		2. Reports.	Pages	Apr. '75	Y	Apr. '75

Table 8.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		BIOLOGY - CHEMISTRY (Cont'd)				
33	Moore	1.	Nearshore Study.		(STORET)	Y	
		3.	Biological analysis.	Mag. tape	(BIOFIND)	Y	
		4.	Temperature and dissolved oxygen profiles.	Pages	Aug. '73	Y	
		5.	Final report.	Pages		Y	
35	Mosley	1.	Benthos Study		(STORET)		
		4.	Final report.	Pages	July '74	Y	July-Aug. '74
60	Stoermer	1.	Phytoplankton	Mag. tape	(STORET)	Y	
		3.	Data count: prereport.	Pages	(CEDDA)	Y	Apr.-July '74
		4.	Final report.	Pages		Y	
62	Sweeny	1.	Nearshore Biology and Chemistry		(STORET)	Y	
		5.	First status report.	Pages		Y	
		6.	Final report.	Pages	July '74	Y	July-Aug. '74
		7.	Biological data.	?	(BIOFIND)	Y	
66	Thomas	1.	Sediment Oxygen Demand		(STORET)	Y	
		3.	First status report.	Pages		Y	
		4.	Final report.	Pages	July '74	Y	July-Aug. '74
67	Thomas		Lake Macrobenthos				
		1.	Distribution of benthic organisms.	Pages		Y	
		2.	Sediment particle size and composition.	Pages		Y	
		3.	Final report.	Pages		Y	
68	Lee	1.	Hazardous Chemicals		(STORET)	Y	
		4.	First status report.	Pages	Jan. '74	Y	Feb.-July '74
		5.	Final report.	Pages	July '74	Y	July-Aug. '74
73	Pinsak		Lake Water Characteristics				
		1.	Edited depth, temperature, and chemical composition data.	Mag. tape		Y	In archive
		2.	Documentation.	Pages		Y	In archive
		3.	Final report.	Pages	July '74	Y	July-Aug. '74
	PANEL		ENERGY BALANCE				
17	Pavlak		Nearshore Ice Formation				
		2.	Meteorological data: automatic van (temp., wind, radiation, pressure).	Mag. tape	July '74	Y	In archive
		3.	Time-lapse photography (ice formation).	Super 8 film	Now	PI	
		4.	Final report.	Pages	(CEDDA)	Y	Apr.-July '74
		5.	Data report.	Pages	(CEDDA)	Y	

Table 8.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		ENERGY BALANCE (Cont'd)				
18	Grumblatt		Water Temperature Gages				
		2.	Raw water temperature, 1/5 min.	Mag. tape	(CEDDA)	Y	In archive
		3.	Final report.	Pages	June '75	Y	June '75
28	Lyons		Cloud Climatology				
		1.	Solar radiation: incident.	Strip chart	Jan. '75	PI	
		2.	1-hr average (planimetered).	Pages		Y	
		3.	Cloud photography: color panorama.	35-mm film frame	Jan. '75	PI	
		4.	Cloud photography: color all sky.	16-mm film	Jan. '75	PI	
		5.	Cloud photography: color all sky.	35-mm film frame	Jan. '75	PI	
		6.	DAPP satellite imagery.	70-mm film frame		?	
			Digitized cloud photographs.		July '75	?	
			Cloud cover mosaics.		July '75	?	
		7.	Final report.	Pages	July '75	Y	July '75
36	Hoffeditz		Evaporation Pan Network (U.S. and Canada)				
		1.	Radiation: incident longwave and shortwave hourly totals.	Punched cards	July '74	Y	July '74
		2.	Evaporation pan data (U.S. and Canada).	Punched cards	Dec. '74	Y	Dec. 74
		4.	Reports and final report describing results.	Pages	Dec. '74	Y	Dec. '74
40	Piech		Lake Optical Properties				
		2.	Turbidity measurements: irradiance meter/transmissometer.	Manual record (pages)	Now	?	
		3.	"	Graphs	Now	?	
		4.	"	Microfiche		Y	
		5.	Documentation: location of measurements, final report.	Pages	Now	Y	Apr.-July '74
54	Quinn		Lake Ice Studies				
		1.	Ice thickness: manual measurement 5 sites, weekly.	Pages	Mar. '74	Y	Mar.-July '74
		2.	Ice pattern: graphic display.	Sheets		Y	
		3.	Surface meteorological data: analog continuous.	Strip chart		PI	
		4.	Albedo measurement.	Page	Mar. '74	Y	Mar.-July '74
		5.	Ice samples: photographs.	Sheets	Mar. '74	Y	Mar.-July '74
61	Strong		Satellite				
		1.	NOAA 2 VHRR digital tapes.	Mag. tape	Sept. '74	Y	Sept. '74
		2.	NOAA 2 VHRR images.	10x10 neg. film		?	
		3.	Final report.	Pages	Sept. '74	Y	Sept.-Oct. '74

Table 8.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	MAJOR U.S. IFYGL SYSTEMS				
100	CEDDA	Physical Data Collection System (PDCS)				
		1. Basic data base in engineering counts.	Mag. tape		PI	Sept. '74
		2. Provisional meteorological and limnological data (6 min).	Mag. tape		Y	Sept. '74
		3. Provisional PDCS data listing.	Microfilm		Y	Sept. '74
		4. Provisional PDCS time series graphics.	Microfilm		Y	Sept. '74
		5. Final meteorological and limnological data (6 min).	Mag. tape		Y	Dec. '74
		6. Final PDCS data listing.	Microfilm		Y	Dec. '74
		7. Final PDCS time series graphics.	Microfilm		Y	Dec. '74
		8. Final meteorological and limnological data (hourly average).	Mag. tape		Y	Dec. '74
		9. Listing of hourly averages and standard deviations.	Microfilm		Y	Dec. '74
		10. PDCS technical manual.	Pages		Y	Sept. '74
		11. Analyst's technical manual and system field documentation.	Pages		Y	Feb.-Mar. '75
	CEDDA	U.S. IFYGL Ship System				
101	Researcher	3. 1-s data: 1/10-s subsurface.	Mag. tape	Now	Y	Apr.-June '74
102	Advance II	4. On-station data: decibar average subsurface data, average value for surface data.	Mag. tape	Dec. '74	Y	May'74-Feb.'75
		5. 6-min average data.	Mag. tape	Dec. '74	Y	May'74-Feb.'75
		6. Radiation data, 6-min total.	Mag. tape	Dec. '74	Y	May'74-Feb.'75
		7. On-station data, 6-min average and radiation data.	Microfilm	Dec. '74	Y	May'74-Feb.'75
		8. Manual observations: raw.	Pages	Now	PI	
		9. Manual observations: edited.	Mag. tape		Y	
		10. Quality control strip charts.	Strip chart	Now	PI	
		11. 9-point digitized EBT.	Punched cards	Now	Y	
		12. EBT-X,Y traces.	Microfilm		Y	
		13. Graphics: 1-s average data.	Microfilm		Y	
		14. EBT graphics.	Microfilm		Y	
		15. 1-s average data listing.	Microfilm		Y	
		16. Researcher dissolved oxygen traces.	Graphs		Y	May '74
103	CEDDA	Rawinsonde				
		2. Raw rawinsonde data: copy of field data tapes.	Mag. tape	June '74	PI	
		3. Raw data: meteorological parameters, Loran signal.	Strip chart	June '74	PI	
		4. Raw data time series plots.	Microfilm	June '74	Y	Apr.-Aug. '74
		5. Final data 5-s average meteorological parameters.	Mag. tape	June '74	Y	In archive
		6. Final 10-mb data.	Mag. tape	June '74	Y	June-Aug. '74
		7. Final 50-mb data.	Mag. tape	June '74	Y	June-Aug. '74
		8. Adiabatic charts.	Microfilm	June '74	Y	June-Aug. '74
		9. Original calibration documents.	16-mm microfilm	June '74	PI	
		10. User's guide.	Pages		Y	
		11. Downtrack trace	Mag. tape		?	
		12. Prefinal (5 s, 10 mb, 50 mb).	Mag. tape		Y	

Table 8.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	MAJOR U.S. IFYGL SYSTEMS (Cont'd)				
106	CEDDA	Research Flight Facility (RFF)				
		RFF cloud cover photography.				
117	CEDDA	Satellite Data				
	1.	ATS III images.	Film neg.		?	
	2.	DAPP: Air Force meteorological satellite.	Film		?	
	3.	NOAA 2 VHRR.	Film		?	
	4.	"	Mag. tape		?	
	5.	Scanning radiometer (visible and IR).	Film		?	
	6.	"	Mag. tape		?	
	7.	ESSA 9 AVCS.	Film		Y	
	PANEL	TERRESTRIAL WATER BALANCE				
13	Embree	Soil Moisture and Snow Hydrology				
	2.	Soil moisture tabulated data (1/month).	Sheets	Now	Y	Apr.-July '74
	3.	Snow depth-water equivalent (1/month).	Sheets	June '74	Y	June-July '74
	4.	Stream flow-discharge (intermittent).	Sheets	June '74	Y	June-July '74
	5.	Final report.	Pages	June '74	Y	June-July '74
23	Cox	Outflow Term TWB				
	1.	Discharge St. Lawrence River.	Mag. tape		Y	In archive
	2.	Final report/data report.	Pages		Y	In archive
30	Wilshaw	Lake Water Level Gages - U.S.				
	2.	Raw 5-min water levels.	Mag. tape		Y	Apr.-May '74
	3.	Raw hourly water levels.	Mag. tape		T	In archive
	4.	Edited (converted to common datum) hourly water levels.	Punched cards		Y	
	5.	Final report.	Pages		Y	
39	Peck	Airborne Snow Reconnaissance				
	2.	Report: summary of gamma data.	Pages	Now	Y	Apr.-July '74
	3.	Reports: soil moisture and snow water equivalent.	Pages	Now	Y	Apr.-July '74
	4.	Final report: task summary and results.	Pages	June '74	Y	June-July '74
45	Polcyn	Remote Sensing				
46	Polcyn/ Wezernak 2.	Aerial color photography (transparencies?).	70-mm film	Now	PI	
47	3.	Black and white 9 in.	Prints	Now	PI	
	4.	"	Film neg.	Now	PI	
	6.	Final report.	Pages	June '74	Y	June-July '74
	7.	Aircraft flight data records.	Pages		Y	In archive
48	Quinn	Lake Survey Center Precipitation Gage Network				
	2.	Hourly precipitation amounts.	Mag. tape	(CEDDA)	Y	In archive
	3.	Precipitation: 80 NWS stations.	Mag. tape	Now	Y	Apr. '74
	4.	Daily Lake Ontario basin precipitation.	Pages	Mar. '74	Y	In archive
	5.	Final report.	Pages	Apr. '74	Y	Apr.-July '74

Table 8.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		TERRESTRIAL WATER BALANCE (Cont'd)				
52	Rhodehamel		Groundwater Wells				
		2.	Water levels: continuous-analog.	Strip chart	Now	PI	
		3.	Summary: chronological list of all data.	Sheets	Now	Y	Apr. '74
		4.	Final report.	Pages	June '74	Y	June-July '74
58	Schultz		Runoff				
		1.	Tributary stage levels: continuous analog (4 USGS gages).	Strip chart	Now	Y	Apr. '74
		2.	1 observation/15 min (62 USGS gages).	Punched paper tape	Now	Y	
		3.	Daily data.	Mag. tape	Now	PI	
		4.	Weekly data.	Cards	(CEDDA)	Y	
		5.	"	Page	(CEDDA)	Y	Apr.-July '74
		6.	Tributary stage and discharge at 35 miscellaneous sites: intermittent.	Pages	Now	Y	In archive
		7.	Summary.	Sheet	(CEDDA)	Y	Apr.-July '74
		8.	Final report.	Pages	June '74	Y	June-July '74
69	Wilson		Radar and Precipitation Gage Network				
		1.	Raw radar data: returned echo intensity, compacted.	Mag. tape	Jan. '75	PI	
		3.	Photographs of radar scope.	Microfilm	Now	Y	
		4.	Daily total precipitation amounts (including precipitation gage data).	Mag. tape		Y	
		5.	Technical Manual: documentation.	Pages		Y	
		6.	Report: operation of precipitation and radar network.	Pages		Y	
		7.	Raw precipitation data: Rochester precipitation network.	Punched paper tape	Now	T	In archive
		8.	Documentation: Rochester precipitation network observer's logs.	Pages	Now	PI	
		10.	Precipitation data: Rochester precipitation network.	Mag. tape	Now	Y	In archive
		11.	Raw precipitation data: Oswego snow network.	Strip chart		Y	
		12.	Radar data hourly precipitation amounts (by storm).			Y	In archive
70	Wiesnet/ McGuinnes		Aerial Hydrological Survey				
		7.	Final report.	Pages	Dec. '74	Y	Dec. '74
	PANEL		WATER MOVEMENT				
27	Liu		Waverider Buoy				
		3.	Digitized wave data (3 samples/s).	Mag. tape	Now	Y	Apr. '74
		4.	Hourly summary and plot of digitized wave data.	Mag. tape	July '74	Y	In archive
		5.	"	Pages	July '74	Y	July-Aug. '74
		6.	Final reports.	Pages		Y	

Table 8.--Summary of data for final IFYGL Archive: United States (Cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	WATER MOVEMENT (Cont'd)				
34	Mortimer	Temperature Transect				
		1. Water temperature/depth MBT.	Slides	Now	Y	Apr.-July '74
		5. Cross section plots.	Sheets	Apr. '74		Apr.-July '74
		6. Final report.	Pages	Apr. '74		
55	Saylor	Lagrangian Current Measurements				
		1. Current drogue daily plot.	Sheets	Sept. '74	Y	Sept. '74
		2. Water temperature daily charts.	Sheets	Sept. '74	Y	Sept.-Oct.'74
		3. Water temperature EBT x-y plot.	Sheets	Now	Y	Apr.-July '74
		4. Water temperature reversing thermometer.	Sheets	Now	Y	Apr.-July '74
		5. Final report.	Pages	Sept. '74	Y	Sept.-Oct.'74
56	Saylor	Current Measurements - PDCS Buoys				
		1. Final edited current data.	Mag. tape	Jan. '75	Y	Jan. '75
		2. Current/wind daily charts.	Sheets	Sept. '74	Y	Sept. '74
		3. Final report.	Pages	Dec. '75	Y	Dec. '74
59	Scott	Coastal Chain		NCC NCC		
		1. Current/water temperature.	Mag. tape		Y	In archive
		2. Final and basic data report.	Pages		Y	In archive

Table 9.--Summary of data for final IFYGL Archive: Canada

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		ATMOSPHERIC BOUNDARY LAYER				
5	Donelan		Direct Measurement of Energy Fluxes				
		1.	Niagara Bar micrometeorological site: 10-and 30 min-averages of wind-speed, air temperature, humidity, wind direction, and surface water temperature.	Manual records Mag. tape	Oct. '73	Y	
		2.	30-min averages of solar radiation, net radiation, and water level.	Manual records	Dec. '73	Y	
		3.	30-min averages of friction velocity, sensible heat flux, latent heat flux, drag coefficient, heat flux coefficient, and moisture flux coefficient.	Manual records	Apr. '73	Y	
15	McBean Morrissey		Space Spectra in The Free Atmosphere				
		1-2.	Mesoscale meteorological data provided by low-level research flights.	Report Mag. tape		Y	In archive
28	McBean Martin Polavarapu		Momentum, Heat, and Moisture Transfer				
		1.	Niagara Bar micrometeorological site: wind, temperature, wet-bulb temperature data, fluxes of momentum, heat, and water vapor from eddy correlation measurements.	Manual records	Sept. '73	Y	
		2.	As above except temperature and wet-bulb temperature.	Manual records	Sept. '73	Y	In archive
		3.	Micrometeorological data.	Manual records	Sept. '73	Y	In archive
44	Elder		Analysis of Energy Fluxes By Aerodynamic Methods				
		1.	Latent, sensible heat transfer for Lake Ontario by weekly periods.	Manual records	Apr. '73	Y	
		2.	Preliminary energy flux estimates.	Report		Y	In archive
		3.	Final estimates.	Report	Apr. '73	Y	
		4.	Preliminary investigation of wind stress field over Lake Ontario.	Report		Y	In archive
75	Smith		Wind and Temperature Fluctuations				
		1.	Niagara Bar west mast wind and temperature fluctuations, June '72 preliminary data.	Manual records	Jan. '73	Y	In archive
		2.	Niagara Bar center mast wind, temperature, and humidity fluctuations, June '72 final data (supersedes preliminary data above).	Report	Mar. '73	Y	In archive
		3.	Bedford buoy #1 wind and temperature fluctuations, Oct. '72. Eddy flux measurements over Lake Ontario.	Report	Apr. '73	Y	

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
97	Elder	Meteorological Buoy Measurements				
	1.	10-min observational data.	Mag. tape	May '73	Y	In archive
	2.	1-hr averaged data.	Mag. tape	May '73	Y	
	3.	Field report.	Report		Y	In archive
	4.	Summary of meteorological buoy and manual measurements.	Report		Y	In archive
107	Shaw Whelpdale	Air Pollution Sinks				
		Sulphate deposition by precipitation.	Report		Y	In archive
	PANEL	BIOLOGY - CHEMISTRY				
54	Gorman Fitzpatrick Ambrase	Groundwater Supply Near Kingston				
		"A Geochemical Study of Deadman Bay Near Kingston, Eastern Ontario" by Laura M. Johnston.	Report		Y	In archive
81	Salbach	Material Balance Lake Ontario				
	1.	Niagara River range: preliminary.	Printout	Jan. '73	Y	
	2.	St. Lawrence River range: preliminary	Printout	Jan. '73	Y	
	3.	IFYGL '72 inland water quality monitoring program: preliminary.		Jan. '73	Y	In archive
82	Watson	Lake Ontario Zooplankton Migration				
	1.	"Energetics of Vertical Migration in Mysis relicta Loven, 1862" (Crustacea, Mysidacea) by James B. Foulds.	Report	Oct. '72	Y	In archive
	2.	Zooplankton vertical distribution with temperature, light, and chlorophyll data at three stations: Toronto, Midlake, and Oshawa.	Punched cards	May '73-Jan.'74	Y	
	3.	Station 2: field nutrient excretion laboratory data nutrient regeneration.	Manual records		Y	
83	Christie	Cooperative Studies Of Fish Stocks				
		DECCA readings: trawl drags.	Manual records		Y	In archive
85	Shiomi	Nutrient Cycles, Lake Ontario				
		Chemical data from OOPS cruises.	Mag. tape	July '74	Y	
86	Nicholson	Lake Ontario Surface Plankton Survey				
		Pigment analysis: chlorophyll "A".	Report		Y	In archive
98	Carpenter	Lake Ontario Cross-Section Study				
	1.	Vertical and horizontal distribution of zooplankton. Distributions, life histories, and biomass production in relation to physical-chemical parameters.	Manual records Punched cards Maps/charts	Mar. '74	Y	
	2.	Vertical profiles of phytoplankton and horizontal abundance.	Manual records	Mar. '74	Y	

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		BIOLOGY - CHEMISTRY (Cont'd)				
101	Glooschenko		Lake Ontario Primary Production Study				
		1.	"Primary Production at an Inshore and Offshore Station on Lake Ontario During IFYGL" by P. Stadelmann and J. Moore.	Report	Jan. '74	Y	In archive
		2.	EBT.	Cards		Y	In archive
102	Glooschenko		Lake Ontario Diel Pigment Variation				
			Chemical values of chlorophyll, and Lake Ontario diel pigment variation.	Manual records	Aug. '73	Y	
103	Gilbertson		Pesticide Concentration in Birds' Eggs	Manual records			
104	Shiomi		Rain Quality Monitoring				
			Rain chemistry analysis: "Chemical Composition of Precipitation During IFYGL" by M.T. Shiomi.	Report	Dec. '74	Y	
	PANEL		ENERGY BALANCE				
8	Robertson		Shore Gauging Stations				
		1.	Hourly averaged water temperature from Kingston, Pt. Petre, Cobourg, Toronto, Oshawa, and Burlington.	Punched cards		Y	
		2.	10-min observations of water temperature from Pt. Petre, Cobourg, Toronto, Oshawa, and Burlington.			Y	
32	Rodgers		Thermal Bar Study				
			Data analysis of core information.	Manual records		Y	
42	Boyce		Heat Storage of Lake Ontario				
		1-10.	Heat content survey of Lake Ontario, 1972: reports 1-10.	Manual records	Apr. '72-Mar. '73	Y	In archive
		11.	Nine-point EDT digitization: one deck per survey.	Punched cards	Aug. '73	Y	
63	Fitzpatrick		Airborne Ice Reconnaissance	70-mm film			
71	Latimer		Canadian Radiation Network				
		1-2.	Raw data from Atmospheric Environment Service (AES) radiation installations.	Printer tape Analogue charts		Y	
		3.	Documentation.	Papers		Y	In archive
72	Ramseier		Floating Ice Research				
			Navigation season extension studies, Gulf of St. Lawrence to Great Lakes, winter '72-'73.	Report		Y	In archive

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		ENERGY BALANCE (Cont'd)				
73	Judge		Terrestrial Heat Flow				
		1.	"Terrestrial Heat Flow through Lake Ontario" by A. Judge and B. Henry.	Report	Jan. '74	Y	
		2.	Mud temperature gradient.		Jan. '74	Y	
		3.	Thermal conductivity of Lake Ontario.		Jan. '74	Y	
		4.	Bottom water temperature.	70-mm film	Jan. '74	Y	
80	Davies		Radiation Balance Program				
		1-2.	Radiation data from Canadian land and lake stations.	Mag. tape Printout	May '73	Y	In archive
87	Boyce		Heat Flow to Lake Ontario				
		1.	Minor turbidity heat contribution to Lake Ontario.	Manual records	Oct. '73	Y	
		2.	Minor turbidity heat contribution to Lake Ontario.	Maps/ charts	Oct. '73	Y	
88	Boyce		Temperature Measurements				
			Instrumentation report.	Manual record	Jan. '74	Y	
	PANEL		FIELD SUPPORT				
1	Thomson		Remote Sensing				
		1.	"Lake Dynamics Utilizing Sun-Glint" by R.P. Bukata and W.D. McColl.	Report	June '73	Y	
		2.	"Infrared surveys of Lake Ontario" by K.P.B. Thomson.		June '73	Y	
30	Rodgers		IFYGL Operations - CCGS Porte Dauphine				
		1.	Temperature EBT.	Punched cards	June '73	Y	In archive
		2.	Conductivity of surface water.		June '73	Y	
		3.	Chlorophyll samples.		June '73	Y	
		4.	Hourly meteorological weather data.		June '73	Y	
		5.	Radiation data.		June '73	Y	
68			CCIW Supporting Resources				
		1.	Shipboard data.	Mag. tape		Y	In archive
		2.	Nine-point BT documentation.	Report		Y	In archive
		3.	TSAR	Report			In archive
		4.	Shipboard data.	Punched cards		Y	In archive
79	McCulloch		Bathymetric Surveys - Lake Ontario				
			Lake Ontario bathymetric data.	Mag. tape	Apr. '73	Y	In archive
94	MacPhail		Data Retransmission by Satellites				
			Data retransmission.	Report	Apr. '73	Y	In archive

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		LAKE METEOROLOGY AND EVAPORATION				
16	Irbe		Airborne Radiation Thermometer Surveys				
			Airborne radiation thermometer maps of Lake Ontario.	Maps		Y	In archive
18	McCullobh		Climatological Network				
		1.	Monthly reco d of Canadian meteorological data.	Manual records		Y	In archive
		2.	Monthly record of Canadian meteorological data.	Mag. tape		Y	In archive
20	McCulloch		Bedford Tower Program				
			Bedford tower meteorological data.	Mag. tape	Jan. '74	Y	
21	McCulloch		Canadian Shoreline Network				
			Meteorological data: shoreline stations.	Mag. tape	Jan. '74		
23	Pollock		Precipitation in Canada				
		1.	Daily values of precipitation on a gridpoint basis.	Mag. tape	Oct. '74	Y	
		2.	Distrometer and rain-gauge data.	Manual records	Jan. '74	Y	
25	Irbe		Lake Ontario Evaporation by Mass Temperature				
			Mass transfer (operational) evaporation estimates: monthly.	Papers		Y	In archive
27	McCulloch		Island Precipitation Network Contained in AES Publications				
			Supplementary precipitation data.	Manual records	Mar. '74	Y	
64	Ferguson		Basin Evapotranspiration				
			Monthly maps of evapotranspiration for basin.	Maps	Dec. '73	Y	
65	McCulloch		Evaporation Pan Network				
			Evaporation pan documentation.	Papers		Y	In archive
	PANEL		TERRESTRIAL WATER BALANCE				
11	Witherspoon		Monthly Water Balance of Lake Ontario Basin				
		1-4.	Monthly means of regional land evaporation, regional land precipitation, regional land runoff, and basin change in storage.	Manual records	Mar. '73	Y	

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		TERRESTRIAL WATER BALANCE (Cont'd)				
12	Witherspoon		Monthly Water Balance of Lake Ontario				
		1-6.	End-of-month water levels, monthly mean outflow and inflow, monthly mean land runoff, precipitation on lake (shore station), and evaporation from lake surface.	Manual records	Mar. '74	Y	
13	Ryckborst		Groundwater Flow Into Lake Ontario				
		1.	"Regional Groundwater Flow Between Lake Simcoe and Lake Ontario" by C.J. Haefeli.	Report	Oct. '72	Y	In archive
		2.	"Groundwater Inflow Into Lake Ontario From the Canadian Side" by C.J. Haefeli.	Report	Oct. '72	Y	In archive
		3.	"Linear Synthetic Hydrographs From Southern Ontario" by H. Ryckborst and E. Wojtek.	Report		Y	
14	Russell		Hydrology of Lake Ontario				
			Streamflow data for selected stream tributaries to Lake Ontario.	Computer sheets	June '73	Y	In archive
38	Ostey		Groundwater Contribution to Lake Ontario				
		1.	Observation wells.	Manual records	May '73	Y	
		2.	Snow courses.			Y	
		3.	Soil moisture.			Y	
		4.	Overburden well yields.	Maps		Y	In archive
		5.	Hydrology of the Forty Mile Creek drainage basin.	Report		Y	In archive
		6.	Lake Ontario drainage basin.	Maps		Y	In archive
49	Adams		Snow Stratigraphy and Distribution				
		1-6.	Peterborough area: precipitation, rainfall, snowfall, accumulative gauge, temperature measurements, and sky cover.	Manual records	June '73	Y	
		7.	Peterborough area: snow stratigraphy and distribution.	Report		Y	In archive
69	Henderson		Pleistocene Mapping	Maps/ charts	Apr. '74	Y	
74	Dohler		Water Level Network				
		1-6.	Water level data for Port Weller, Toronto, Burlington, Cobourg, Point Petre, and Kingston.	Punched cards	Apr. '74	Y	
		7.	Format of hourly height cards with header and monthly extreme cards.			Y	In archive
		8.	Water levels.	Mag. tape		Y	In archive

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	TERRESTRIAL WATER BALANCE (Cont'd)				
78	Sanderson	Basin Water Balance				
		Estimation of basin evaporation by the Thornthwaite method.	Manual records	Dec. '75	Y	
108	Dohler	Lake Level Transfer				
		Water level data for Point Petre pressure transducer sensor.	Punched cards	May '72	Y	In archive
116	Loijens	Airborne Gamma-Ray Snow Survey				
		"Airborne Measurement of Snow-Water Equivalent Using Natural Gamma Radiation Over Southern Ontario, 1972-73" by H.S. Loijens and R.L. Grasty.	Report	Aug. '73	Y	
	PANEL	WATER MOVEMENTS				
3	Weiler	Statistical Prediction of Lake Currents				
		Lake current models.	Manual records	June '74	Y	
34	Rodgers	Circulation Near Toronto				
		1. Tower study: current speed and direction.	Punched cards	May '73	Y	
		2. Tower study: temperature of water at two levels.	Punched cards	May '73	Y	
40	Csanady	Coastal Chain Study				
		1. Provisional reports.	Papers		Y	In archive
		2. Final report.	Report		Y	In archive
		3. Unsummarized data.	Punched cards		Y	
		4. Daily summary: Oshawa.	Punched cards		Y	In archive
43	Boyce	Internal Wave Measurements				
		1. Transect cross section.	Maps/ charts	Aug. '73	Y	
		2. Fixed temperature profiler (FTP) data file.		Oct. '73	Y	
		3. Transect tape.			Y	
		4. FTP data file.	Mag. tape	Oct. 73	Y	
		5. Transect tapes.		Oct. '73	Y	
45	Bennett	Lake Current Measurements				
		1. Header information for 10-min current flow and temperature data from CCIW moorings.	Manual records	June '73	Y	
		2. 10-min current flow and temperature data from CCIW moorings.	Mag. tape	June '73	Y	In archive

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL		WATER MOVEMENTS (Cont'd)				
70	Falconer		Ground Truth For Remote Sensing				
			Descriptive analysis of ERTS and analogue aircraft data applied to IFYGL hydrological objectives.	Manual records	Dec. '74	Y	
76	Holland		Surface Wave Studies				
		1-2.	Characteristics of waves incurred in Lake Ontario off Cobourg.	Manual records	June '73	Y	
				Mag. tape	June '73	Y	In archive
		3.	"Wave Climate Project for Cobourg."	Papers		Y	
		4-5.	Characteristics of waves incurred off Main Duck Island.	Manual records		Y	In archive
				Mag. tape		Y	
		6.	"Wave Climate Project for Main Duck Island."	Papers	Oct. '73	Y	
		7-8.	Characteristics of waves incurred off Toronto.	Manual records		Y	
				Mag. tape		Y	In archive
		9.	"Wave Climate Study Project for Toronto."	Papers	Oct. '73	Y	
		10.	Format of wave climate study.	Papers		Y	In archive
89	Murthy		Turbulent Diffusion Studies				
		1.	"Large Scale Diffusion Studies" by C.R. Murthy, K. Miners, G. Kullenberg, and H. Westerberg.	Report	Dec. '73	Y	
		2.	"Near Shore Diffusion Studies" by C. R. Murthy and K. Miners.	Report		Y	
95	Simons		Hydrodynamical Modelling				
		1.	"Surface Wind Stress Analysis Over Lake Ontario for IFYGL" by P. Hamblin.	Report	Apr. '73	Y	
		2-3.	Reports on significant episodes during IFYGL prepared under project code name "MOVER" 3/72 - 12/72 and 6/2/72 - 6/30/72.	Reports	Apr. '73	Y	
		4.	Reports on storm surges during IFYGL.	Reports	Oct. '73	Y	
		5.	Reports on model verification for episodes analyzed under project "MOVER".	Reports	Apr. '73	Y	
		6.	First report: model study of AGNES storm, 3/72 - 12/72 and 6/2/72 - 6/30/72.	Report	Apr. '73	Y	In archive
		7.	Model study of BETTY storm.	Report		Y	In archive
109	Rodgers		Upwelling Study				
			Water temperature (EBT): several surveys of 45 stations each, all off Toronto-Oshawa area.	Punched cards		Y	
110	Arajs		Hydro Intake Study				
		1-17.	Water currents and temperatures: Chub Point, Bowmanville, Weoleyville, Pickering, and Lennox.	Manual records Punched cards		Y	In archive

Table 9.--Summary of data for final IFYGL Archive: Canada (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
	PANEL	WATER MOVEMENTS (Cont'd)				
111.	Palmer	Lakeview Dispersion Study				
	1.	Current meter data from Lakeview, Ontario.	Mag. tape	May '73	Y	In archive
	2.	Current meter data from Lakeview, Ontario.	Manual records	May '73	Y	
115	Cho	Wave Climatology	Punched cards	June '73	Y	

EDITING PROCEDURES FOR ANALYSIS OF BUOY AND TOWER DATA

R.L. Pickett and F.P. Richards

The following editing procedures, in terms of time and space, have been developed for analysis of IFYGL buoy and tower data. So far, these procedures have been applied to the data for July 1972.

Time Edit

Several steps were involved in editing the July 1972 buoy and tower data and in generating hourly average air and water temperatures, wind and current speeds and directions, and atmospheric pressure.

(1) Data values outside sensor ranges (IFYGL Bulletin No. 8, p.76) were eliminated. The remaining data were then screened by using the following climatological bounds given below.

Wind Speed Bounds

Upper	30 m/s.
Lower	0 m/s.

Monthly Water Temperature Bounds

	Jan.	Feb.	Mar.	Apr.	May	June
Upper (°C)	15.0	15.0	20.0	20.0	25.0	29.0
Lower (°C)	-1.0	-1.0	-1.0	0.2	0.2	1.0

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Upper (°C)	29.0	29.0	29.0	25.0	25.0	20.0
Lower (°C)	2.0	3.0	2.0	1.0	1.0	0.2

Monthly Air Temperature Bounds

	Jan.	Feb.	Mar.	Apr.	May	June
Upper (°C)	15.0	15.0	20.0	30.0	35.0	40.0
Lower (°C)	-25.0	-25.0	-25.0	-15.0	-5.0	0.0

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Upper (°C)	40.0	40.0	35.0	30.0	25.0	20.0
Lower (°C)	5.0	5.0	-5.0	-10.0	-25.0	-25.0

(2) Temperature, speed, and pressure histograms were then computed. These variables are assumed to have continuous distributions. Therefore, in

cases where the histogram gap on both sides of a given data point exceeded the values given below, that data point was discarded.

Water temperature	1.25°C
Current speed	8.0 cm/s
Air temperature	1.0°C
Wind speed	4 m/s
Atmospheric pressure	4.0 mb

(3) A three-point smoother was applied to simulate a longer sensor response time. The object was to make the instantaneous United States and integrated Canadian data more compatible. First, intermediate values, X', were generated:

$$X'_i = 0.5\ X_i + 0.25\ (X_{i+1} + X_{i-1}).$$

Next, longwave amplitudes were restored:

$$Y_i = 1.5\ X'_i - 0.25\ (X'_{i+1} + X'_{i-1}).$$

This smoother discarded data values at the beginning and end of a data series (start or end of a record, or at gaps), because such points were often found to be spurious.

Surviving data (maximum of 10 United States and 6 Canadian values) were used to compute hourly averages. To compute vector averages, u and v components were determined, and the resultant speeds and directions were calculated from these components.

The last time edit consisted of manual scanning of rejected data. If, based on this scanning, rejection was found to be questionable, the data point was reinstated.

<u>Space Edit</u>

Comparisons between stations were made by calculating for each station and each depth monthly means, variances, skewness, kurtosis, and spectra. These statistics were examined, and radically different stations were in some cases discarded.

Daily statistics of all remaining variables at all levels were then computed. If a station differed from the daily mean at that level by more than three standard deviations, it was flagged, inspected, and, in some instances, discarded.

<u>Results</u>

The data from July 1972 produced by these editing procedures have been put on seven-track magnetic tape.

COMPARISON OF JULY CURRENTS FROM ADJACENT UNITED STATES AND CANADIAN BUOYS

R.L. Pickett and F.P. Richards

The following describes a comparison of monthly mean currents for July 1972 as measured at -15 m by United States and Canadian buoys at station 13 (approximately 43°26'N, 78°44'W).

Speed and Direction

Overplotting of speeds and directions based on a 3-day sample from the two buoys showed that the systems tracked each other fairly well (fig. 13). Current direction statistics were then compared, for which Kolmogorov-Smirnov 95 percent confidence limits were used. The resulting frequency distributions were not significantly different, as shown below.

	Percent of Observations							
Direction	N	NE	E	SE	S	SW	W	NW
United States	13	12	14	12	10	12	16	12
Canada	13	16	15	15	10	6	12	14

Calculation of scalar speeds yielded monthly means of 5.4 cm s^{-1} for the United states buoy, and 8.1 cm s^{-1} for the Canadian, a significant difference. Since there were high frequencies in the data, hourly averages were computed from the 6-min United States and 10-min Canadian observations. When the monthly scalar speeds were recalculated based on the hourly averages, the results were 5.3 cm s^{-1} for the United States data and 7.7 cm s^{-1} for the Canadian, a slightly smaller difference, but still a significant one.

The data were subjected to a final screening. If during this process an hourly observation was missing in one of the two data sets, the corresponding observation was removed from the other set. Monthly mean values from the resulting joint values were 5.3 cm s^{-1} for the United States system and 7.3 cm s^{-1} for the Canadian. Although these values come closer than the ones given above, significant differences remain (table 10).

Scatter

Comparison of scatter in the two speed distributions showed a standard deviation for both systems of 4.6 cm s^{-1}. However, although the standard deviations were equal, the scatter could have been distributed differently among the various frequencies. As a check on the relative frequency response of the two systems, power spectra of both sets of current speed data were calculated. The spectra were found to be almost identical, the maximum difference in any frequency band up to 0.5 cycles/hr being only 2 percent.

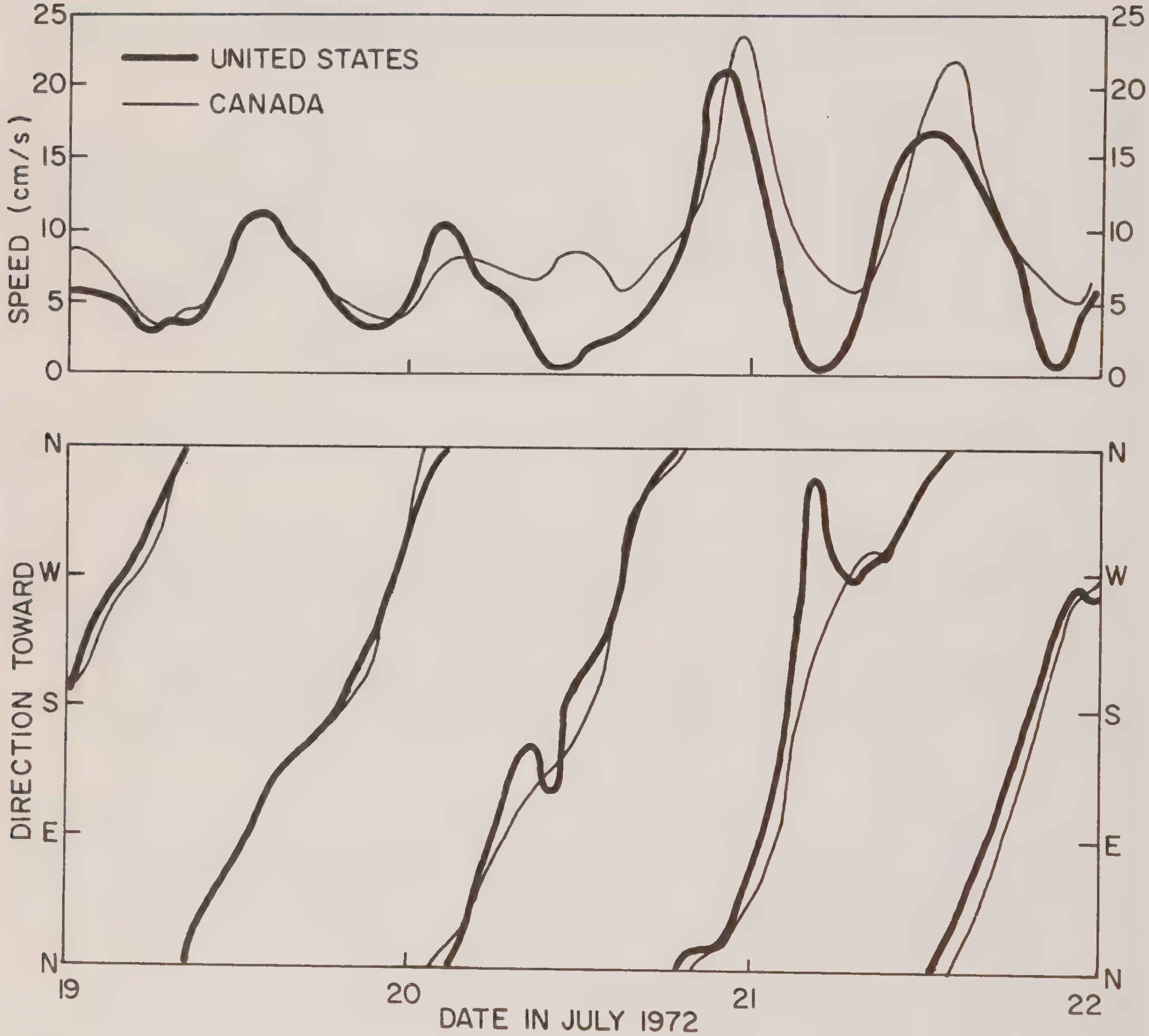


Figure 13.--Sample of station 13 current data.

Table 10.--Joint distribution of speeds in percent of total observations

Speed, $cm\ s^{-1}$, Canadian buoy	Speed, $cm\ s^{-1}$, United States buoy 1	3	5	7	9	11	13	15	17	Sum
1	6	0	0	0	0	0	0	0	0	6
3	11	3	2	1	0	0	0	0	0	17
5	6	6	3	2	2	0	0	0	0	19
7	4	4	5	5	2	1	0	0	0	20
9	1	2	2	4	3	2	2	0	0	16
11	0	1	1	2	1	2	1	0	0	8
13	0	1	0	0	1	0	1	1	0	4
15	0	0	0	0	1	0	0	0	1	2
17	0	0	0	0	0	0	1	0	0	1
Sum	28	17	13	13	10	5	5	1	1	93

The two systems appeared thus to have speed distributions with different means, equal scatter, and matched frequency responses. In other words, the two data sets seemed to differ by a bias of 2 cm s^{-1}. The question remaining was which system was closer to the true value. Additional current observations taken at station 13 by J.T. Scott ("U.S. IFYGL Coastal Chain Program," Report 1C, State University of New York at Albany) at first seemed an answer to this question. Unfortunately there were very few simultaneous observations and so much scatter in the data that no significant differences could be found among the three data sets.

Applicability to All Stations

Another question was whether the differences at station 13 were characteristic of all United States and all Canadian stations. To check this possibility, hourly averages for all United States stations at -15 m were combined, and the same was done for the Canadian stations. When the lakewide means were compared, the results were 3.3 cm s^{-1} for the United States data and 5.2 cm s^{-1} for the Canadian. Hence the mean difference between the Canadian and United States systems at station 13 (2.0 cm s^{-1}) is comparable to the mean difference between all Canadian and all United States buoy systems (1.9 cm s^{-1}). This suggests that the differences apply not only to station 13, but that the cause may lie in basic system differences. (Further evidence of system differences were uncovered by comparing all United States and all Canadian data at -30 m, which showed an even greater discrepancy, i.e., 1.2 cm s^{-1} vs. 4.7 cm s^{-1}).

System Differences

There are several differences between the systems: The United States values are instantaneous, the Canadian are integrated; the United States buoy has a surface float and a ducted directional meter, the Canadian buoy has a subsurface float and an omnidirectional meter (IFYGL Bulletin No. 3).

Editing procedures and hourly averaging as described in this Bulletin under "Editing Procedures for Analysis of Buoy and Tower Data" should have minimized response time problems, but differences attributable to surface and subsurface floats abound. The consensus from articles in MODE Hot Line News (Nos. 10, 12, 16, 21, 40, and 44, Woods Hole Oceanographic Institution, 1972-73) seems to be that, with similar sensors, subsurface-moored meters should record lower speeds than surface-moored ones because of reduced wave pumping and mooring motion. Just the opposite was observed in this study, but the sensors were not similar. The United States ducted meter was designed to respond only in the direction it was aimed, and to subtract backward rotations of the impeller from forward ones. In contrast, the Canadian omnidirectional Savonius rotor could have accumulated residual wave or mooring motion to produce a higher reading. In MODE Hot Line News No. 44, W. Biocourt compared adjacent rigid-tower and subsurface-moored Savonius rotors and found that "sizeable errors originate from the motion of the taut-wire mooring." The Savonius rotors on the taut wire tended to read too high.

Another argument for a lower mean speed could be based on threshold speeds. All current meters have some threshold (about 2.0 cm s^{-1} for the sensors discussed here) below which the impeller will not start spinning. Statistically, one might expect a larger number of zero readings as the current speed oscillates. And, in fact, of the United States observations, 23 percent showed readings of less than 1 cm s^{-1} and 28 percent readings of less than 2 cm s^{-1}, while of the Canadian readings, 0 percent was less than 1 cm s^{-1} and only 6 percent were less than 2 cm s^{-1}. The Canadian proportions of low speeds seem small.

Results

The final step in the comparison was calculation of the July monthly currents. Hourly averages were broken into components, the components were averaged over the month, and the vectors were reconstituted. The results were 0.7 cm s^{-1} at 040° for the United States data, and 1.2 cm s^{-1} at 070° for the Canadian data. These values are not significantly different because of their small magnitude and large variances.

Summary

The Canadian system at station 13 recorded significantly larger scalar mean currents than the United States system. This difference seems to apply to all buoy stations. It does not appear to result from directional sensors, scatter in the data, or relative frequency response of the systems. The difference seems to be attributable to a bias, possibly in the Canadian sensors.

FROM THE DESK OF THE U.S. IFYGL COORDINATOR

Because of demands of other duties, C.J. Callahan has resigned as U.S. Coordinator, IFYGL, after having done an outstanding job over the past 3 years. He will be greatly missed by all those who worked with him.

U.S. IFYGL participants are requested to submit all IFYGL-related publications to the U.S. IFYGL Data Center. Eight copies are required, of which two will be forwarded to the U.S. IFYGL Project Office, two will remain in the U.S. IFYGL Data Center, and four will be submitted to the Canadian Data Center. Please address publications to:

Center for Experiment Design and Data Analysis
Environmental Data Service, NOAA
Page Building 2
Washington, D.C. 20235

Attention: IFYGL Data Manager, D2x1

C.F. Jenkins
U.S. Coordinator
IFYGL

U.S. PUBLICATIONS ON IFYGL

Almazan, J.A., "A Preliminary Analysis of IFYGL Surface Meteorological Data," Proceedings of the 16th Conference on Great Lakes Research, International Association for Great Lakes Research, 1973, pp. 468-483.

Armstrong, D.E., and R.F. Harris, "Phosphorus Uptake and Release by Lake Ontario Sediments (IFYGL)," First Annual Report of the EPA IFYGL Projects, Ecological Research Series, EPA 660/3-73-021, 1973, pp. 123-140.

Csanady, G.T., "Spring Thermocline Behavior in Lake Ontario During IFYGL," WHOI Contribution No. 3053, Woods Hole Oceanographic Institution, Woods Hole, Mass., 1974, 67 p.

DeCooke, B.G., and D.F. Witherspoon, "A Preliminary Lake Ontario Water Balance During IFYGL," Proceedings of the 16th Conference on the Great Lakes Research, International Association for Great Lakes Research, 1973, pp. 675-683.

EPA, "Occurrence and Transport of Nutrients and Hazardous Polluting Substances," First Annual Report of the EPA IFYGL Projects, Ecological Research Series, EPA 660/3-73-021, 1973, pp. 1-28.

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